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- Scientific and technical reports of government agencies, universities, and research organizations throughout the world.

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Readers are encouraged to examine the abstracts in each category of interest. If time is short, and when interest is concentrated in specific areas, readers may wish instead to scan source, author, and subject indexes. A more thorough coverage of a subject field may often be achieved by detailed examination of the subject listings, especially as they are cross-indexed in the quarterly indexes.

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Organizations having a NASA contract may obtain *IAA* by writing NASA, Code USS-A, Washington, D.C., 20546. Others should direct inquiries to the American Institute of Aeronautics and Astronautics, 750 Third Avenue, New York, N.Y. 10017.

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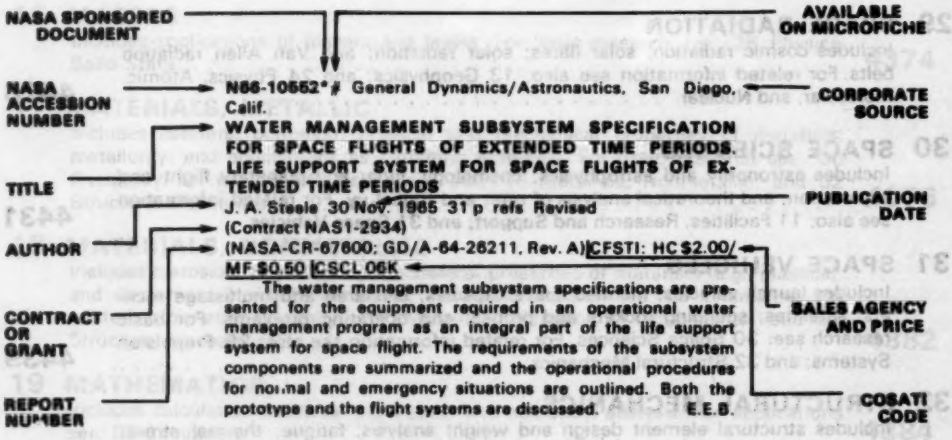
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NASA ACCESSION NUMBER
N66-10552* # General Dynamics/Astronautics, San Diego, Calif.
CORPORATE SOURCE
WATER MANAGEMENT SUBSYSTEM SPECIFICATION FOR SPACE FLIGHTS OF EXTENDED TIME PERIODS. LIFE SUPPORT SYSTEM FOR SPACE FLIGHTS OF EXTENDED TIME PERIODS
TITLE
PUBLICATION DATE
J. A. Steele 30 Nov. 1965 31 p refs Revised
AUTHOR
(Contract NAS1-2934)
(NASA-CR-67600; GD/A-64-26211, Rev. A) CFSTI: HC $2.00/MF $0.50 CSCL 06K
CONTRACT OR GRANT
SALES AGENCY AND PRICE
The water management subsystem specifications are presented for the equipment required in an operational water management program as an integral part of the life support system for space flight. The requirements of the subsystem components are summarized and the operational procedures for normal and emergency situations are outlined. Both the prototype and the flight systems are discussed. E.E.B.
REPORT NUMBER
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VOLUME 4 NUMBER 22

Scientific and Technical Aerospace Reports

A Semimonthly Publication
of the National Aeronautics and Space Administration

November 23, 1966

01 AERODYNAMICS

Includes aerodynamics of bodies, combinations, internal flow in ducts and turbo machinery; wings, rotors, and control surfaces. For applications see: 02 Aircraft and 31 Space Vehicles. For related information see also: 12 Fluid Mechanics; and 33 Thermodynamics and Combustion.

N66-36485# Aerodynamische Versuchsanstalt, Gottingen (West Germany). Abteilung Gasdynamik.

FORCE AND MOMENT MEASUREMENT OF TWO STANDARD HYPERVELOCITY BALLISTIC MODELS HB1 AND HB2 IN THE HYPERSONIC RANGE [DREI-KOMPONENTENMESSUNGEN AN ZWEI AGARD-EICHMODELLEN HB1 UND HB2 IN HOHEN UEBERSCHALLBEREICH]

K. Lipowski May 1966 29 p refs In GERMAN; ENGLISH summary

(DLR-FB-66-35; AVA-FB-66-06) CFSTI: HC $2.00/MF $0.50

The aerodynamic characteristics normal-force, pitching-moment and axial-force coefficient of two standard hypervelocity ballistic-type models, designated HB1 and HB2, have been investigated for various angles of attack in the hypersonic regime $3.0 \leq Ma \leq 4.85$. As main results normal-force curve slope, center of pressure and axial-force coefficients at zero lift are presented as functions of Mach and Reynolds number in comparison with other test data available. Author

N66-36559# Florida Univ., Port Canaveral.

GLOBAL COVERAGE BY BANKED AEROGLIDE ATMOSPHERIC ENTRY

Paul D. Arthur *In* Canaveral Council of Tech. 3d Space Congr. 1966 p 629-632 refs (See N66-36506 22-30)

Spherical earth analytical results are presented showing a possible bank-speed schedule (the minor circle turn) and the necessary lift-drag ratio for global coverage as a function of initial atmospheric entry speed and other relevant parameters. Global Coverage is available for entry at circular speed for $L/D \geq 3.56$; for entry at parabolic entry speed for $L/D \geq 2.34$. Comparison with optimized bank programs gives indication that this minor circle maneuver is close to "optimum" and will provide a practical guidance scheme for controlled atmospheric entry from space. Author

N66-36650*# Goodyear Aerospace Corp., Akron, Ohio.

STATE-OF-THE-ART STUDY FOR HIGH-SPEED DECELERATION AND STABILIZATION DEVICES Final Report

William C. Alexander and Richard A. Lau 10 Sep. 1966 299 p refs

(Contract NASw-1288)

(NASA-CR-66141; GER-12618) CFSTI: HC $3.75/MF $1.75 CSCL 01D

Documented aerodynamic deployable decelerator performance data above Mach 1.0 is presented. The state of the art of drag and stability characteristics for reentry and recovery applications is defined for a wide range of decelerator configurations. Structural and material data and other design information also are presented. Emphasis is given to presentation of basic aero, thermal, and structural design data to point out basic problem areas and voids in existing technology, such as supersonic "buzzing" of towed porous decelerators in the wake of the forebody, the complete lack of dynamic stability data, and the general lack of aerothermal data at speeds above Mach 5. Author

N66-36805# David Taylor Model Basin, Washington, D. C. Aerodynamics Lab.

A PRELIMINARY INVESTIGATION TO STUDY THE EFFECT OF FLAT SPOILERS ON THE AERODYNAMIC CHARACTERISTICS OF WINGS AT ANGLES OF ATTACK FROM 0° TO 90°

Gary W. Brasseur Apr. 1966 24 p ref

(DTMB-2214; DTMB-AERO-1113; AD-636750) CFSTI: HC $2.00/MF $0.50

Flat spoilers were tested on a semispan wing as a possible leading-edge, upper-surface device for controlling flow separation on wings rotated through 90° for application to tilt-wing V/STOL aircraft. Model tests indicated that a spoiler height of 0.10 wing chord at the 0.15 wing chord location was capable of partially controlling flow separation.

Author (TAB)

N66-36838# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.

ENGINEERING JOURNAL (SELECTED ARTICLES)

21 Jan. 1966 30 p refs Transl. into ENGLISH from Inzh. Zh. (USSR), v. 5, no. 3, 1965 p 416-424; 548-553

(FTD-TT-65-1785; TT-66-60985; AD-630969) CFSTI: HC $2.60/MF $0.50

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N66-36939# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.

FLOW AROUND THIN POINTED CONES OF A VISCOUS HYPERSONIC GAS FLOW

V. N. Gusev, T. V. Klimova et al *In its* Eng. J. (Selected Articles) 21 Jan. 1966 p 1–16 refs (See N66-36938 22-01) CFSTI: HC $2.60/MF $0.50

Problems connected with the flow around thin blunted heat insulating cones at any given angle of attack in hypersonic flow of a viscous gas are discussed. The flow around pointed cones at zero angle of attack is considered, the established law of similarity is utilized to determine the resistance force affecting the body. Forces applied to the bottom section of the body are not considered. Another problem discussed is that of determining the geometric parameters of a cone, assuring minimum resistance when a viscous hypersonic flow is directed around it. Evidence from the range of values of the hypersonic interaction parameter X_{∞} shows that the viscosity exists essentially only at small angles of attack. With the increase in angle of attack, the values of summary forces applied from the side of the viscous hypersonic flow to the streamlined cone coincide with their values, following from the theory of ideal flow. S.P.

N66-36940# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.

CALCULATION OF FLOW NEAR A CRITICAL POINT OF A BLUNTED BODY WITH CONSIDERATION OF STUDY

Ye. A. Romishevskiy *In its* Eng. J. (Selected Articles) 21 Jan. 1966 p 17–26 refs (See N66-36938 22-01) CFSTI: HC $2.60/MF $0.50

Equations are presented for calculating the flow around the forward critical point at hypersonic flow around a blunted body. The role of radiation is characterized on the basis of absorption coefficients and the ratio of the energy irradiated over the characteristic length to the convective transfer of energy in the gas. The system of equations and solutions for symmetrical flow around a blunted body (nose) is presented. Tabulations are included which give values of parameters approximately close to the movement of blunted bodies in dense layers of terrestrial atmosphere at velocities exceeding the first cosmic velocity and at altitudes when radiation appears to be in equilibrium. Several conclusions are presented on the basis of the calculations. It is shown that maximum changes on account of radiation are subject to the parameters of the flow around flow in the vicinity of the breaking point, since the gas particles in that area remain for the longest time and are subject to greater scintillation. S.P.

N66-37043*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.

A QUASI-THREE-DIMENSIONAL METHOD FOR CALCULATING BLADE SURFACE VELOCITIES FOR AN AXIAL FLOW TURBINE BLADE

Theodore Katsanis and Lois T. Dallner Washington, NASA, 1966 42 p refs

(NASA-TM-X-52234) CFSTI: HC $2.00/MF $0.50 CSCL 01A

The aerodynamic design of turbine stator or rotor blades requires accurate determination of the velocity distribution on the blades. For axial flow turbines a quasi-three-dimensional compressible flow analysis has been used successfully for many years. The analysis is based on two methods, one to obtain a blade-to-blade variation of velocity, and the other to obtain the radial variation in velocity. A combination of the methods gives a quasi-three-dimensional compressible flow analysis. Most of the calculations have been incorporated into a program. This report gives a description of the quasi-three-dimensional flow analysis and the Fortran IV computer program. Author

N66-37114*# National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.

FLUTTER TESTS OF SOME SIMPLE MODELS AT A MACH NUMBER OF 7.2 IN HELIUM FLOW

Homer G. Morgan and Robert W. Miller Washington, NASA, Apr. 1959 29 p refs

(NASA-MEMO-4-8-59L) CFSTI: HC $2.00/MF $0.50 CSCL 01A (Declassified)

Results of hypersonic flutter tests on some rectangular models of aspect ratio 1.0 are presented. Most of the tests were conducted at a Mach number of 7.2 in helium and a few were made at a Mach number of 6.9 in air. The flutter of models having double-wedge airfoil sections was found to depend on the thickness of the sections. Piston-theory calculations predicted flutter on the double wedges reasonably well until the thickness parameter Mr approached and exceeded 1.0. Piston-theory calculations were not satisfactory on some flat-plate models with beveled edges. Author

N66-37116*# National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.

TRANSONIC FLUTTER INVESTIGATION OF MODELS OF THE SWEPTBACK WING OF A FIGHTER AIRPLANE

Samuel L. Smith, III and Robert W. Boswinkle, Jr. Washington, NACA, 15 Apr. 1958 31 p refs

(NACA-RM-L58A15) CFSTI: HC $2.00/MF $0.50 CSCL 01A (Declassified)

The wing had an aspect ratio of 3.42 and was swept back 41.1° along the leading edge and 19.3° along the outer part of the trailing edge. A large trailing-edge fillet extended out to 50 percent of the semispan. The main spar was cantilever-mounted inboard of the root. The models were dynamically and elastically scaled in accordance with criteria which include a flutter safety margin. The investigation was made in the Langley transonic blowdown tunnel and covered a Mach number range from 0.75 to 1.32 and simulated altitudes to below sea level. Author

N66-37151*# National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.

AERODYNAMIC-CENTER CONSIDERATIONS OF WINGS AND WING-BODY COMBINATIONS

John E. Lamar and William J. Alford, Jr. Washington, NASA, Oct. 1966 15 p refs

(NASA-TN-D-3581) CFSTI: HC $1.00/MF $0.50 CSCL 01A

Aerodynamic-center variations with Mach number are considered for wings of different planform. The normalizing parameter used is the square root of the wing area, which provides a more meaningful basis for comparing the aerodynamic-center shifts than does the mean geometric chord. The theoretical methods used are shown to be adequate for predicting typical aerodynamic-center shifts, and ways of minimizing the shifts for both fixed and variable-sweep wings are presented. Author

N66-37152*# National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.

CONSIDERATIONS REGARDING THE EVALUATION AND REDUCTION OF SUPERSONIC SKIN FRICTION

John B. Peterson, Jr. and William J. Monta Washington, NASA, Oct. 1966 20 p refs Presented at the Conf. on Aircraft Aerodyn., Langley Res. Center, 23-25 May 1966 Also published in NASA-SP-124; see X66-20041 17-01

(NASA-TN-D-3588; NASA-SP-124) CFSTI: HC $1.00/MF $0.50 CSCL 01A

A comparison is made between previously published experimental data for supersonic turbulent boundary-layer skin friction and the skin-friction predictions obtained by using the Sommer and Short T' and Spalding and Chi methods. Also, various methods for reducing skin friction on the supersonic transport are discussed. Author

N66-37163# Gt. Brit. Ministry of Aviation, London. Technical Information and Library Services.

INCREASING THE EFFICIENCY OF TURBINE DELIVERY SYSTEMS [POVYSHENIE EFFEKTIVNOSTI VY KHLOPNYKH PATRUBKOV TURBIN]

D. I. Morozov Apr. 1966 12 p refs Transl. into ENGLISH from Energomashinostr. (Moscow), v. 5, 1965 p 35-37

(TIL/T-5661)

A mathematical analysis was made of turbine diffusers and delivery systems. A means of increasing their efficiency by introducing an involute volute and a peripheral grid to ensure a radial outflow from the diffuser without disruption of flow is described. Losses in the diffuser and volute were assessed and a mathematical evaluation was made of the optimum rate of expansion, based on the development of the overall radial dimensions and the effective outlet section of the volute. The design principles described are recommended for increasing the efficiency of turbine delivery systems. Author

N66-37180# RAND Corp., Santa Monica, Calif.

AERODYNAMICS OF BODIES OF REVOLUTION. CHAPTER I: BASIC CONCEPTS AND EQUATIONS FOR THE AERODYNAMICS OF BODIES OF REVOLUTION

Nikolai F. Krasnov Aug. 1965 169 p Transl. into ENGLISH of Chapter I of the book "Aerodinamika Tel Vrashcheniia" Moscow, 1964

(LT-65-15; TT-66-60154; AD-625836) CFSTI: HC $5.00/MF $1.00

Aerodynamic forces and moments; the basic features of very high velocity gas flow; the basic concepts and equations for determining the flow parameters; Basic relations for determining gas parameters behind a shock wave; Results from boundary-layer and heat transfer theory. TAB

N66-37239# Cornell Aeronautical Lab., Inc., Buffalo, N. Y.

DEVELOPMENT OF A METHOD FOR PREDICTING THE PERFORMANCE AND STRESSES OF VTOL-TYPE PROPELLERS

Andrew R. Trenka Ft. Eustis, Va., Army Aviation Materiel Labs., Jun. 1966 126 p refs

(Contract DA-44-177-AMC-75(T))

(BB-1846-S-1; USAAVLABS-TR-66-26; AD-635951) CFSTI: HC $4.00/MF $0.75

The report presents a theoretical method which allows the prediction of performance and stress characteristics of a single VTOL-type of propeller-wing-nacelle combination operating in various flight conditions from hovering through transition and into axial flight. The method includes (1) the effects of a distorted wake, i.e., the effects of contraction and radial and axial velocity variations; (2) the effects of hovering close to the ground; (3) the interference effects from a nacelle and wing buried in the propeller slipstream. Also presented are experimental thrust and torque data. However, because of the insufficient accuracy of the experimental data collected, no definite evaluation of the model is made. Author (TAB)

N66-37284*# Wyle Labs., Inc., Huntsville, Ala.

SUPERSONIC TURBULENT SEPARATION TESTS IN THE MARSHALL SPACE FLIGHT CENTER 7" TUNNEL

M. V. Lowson [1965] 18 p refs

(Contract NAS8-11308)

(NASA-CR-78284; TM-65-4) CFSTI: HC $1.00/MF $0.50 CSCL 01A

To obtain sufficient data for predicting acoustic environments beneath regions of separated flow and oscillating shocks, an experimental test program was designed. As a first stage, it is suggested that the tests be limited to a shadowgraph flow visualization for classifying the types of flow; they could also be combined with surface oil-flow visualization, and at a later stage the models could be instrumented for static pressure measurements. The need for running these tests at a sufficiently high Reynolds number is pointed out, and the limitations which this requirement puts on the minimum boundary layer thicknesses are listed. It is proposed that the tests be made on a semicircular section cylinder-flare-cylinder half-model mounted on the wall, which could utilize the wall boundary layer and thus satisfy the boundary layer thickness requirements. The proposed models are four basic 1" diameter half cylinder models to fit Mach 1.5, 2, 2.5, and 3 nozzle liners; and 24 flare models (0.3, 0.8, 1.2, 2.4 stepheights) x 15°, 20°, 45°, 60°, 90° flare angles. M.G.J.

N66-37296*# National Aeronautics and Space Administration. Marshall Space Flight Center, Huntsville, Ala.

ANALYSIS OF THE LINEARIZED SUPERSONIC FLOW ABOUT POINTED BODIES OF REVOLUTION BY THE METHOD OF CHARACTERISTICS

Alan D. Sherer Washington, NASA, Oct. 1966 48 p refs

(NASA-TN-D-3578) CFSTI: HC $2.00/MF $0.50 CSCL 01A

The method of characteristics applicable to the linear potential equation governing the supersonic flow over bodies of revolution at zero and small angles of attack is presented. For axisymmetric flow the equations used are those derived by Sauer and Heinz, whereas for flow due to angle of attack the equations are those derived by Oswatitsch and Erdmann. This analysis investigates the limits of applicability of these methods. The flow field computation was programmed in Fortran IV to be used for computing the axisymmetric and angle of attack flow fields about convex and concave parabolic ogives and cone-cylinder bodies of various body fineness ratios at low supersonic Mach numbers. The results of these computations were compared with J. L. Sims' exact method of characteristics, and, whenever available, with experimental data. It was found that these methods are applicable to flow fields where the hypersonic similarity parameter, $M_\infty\epsilon$, is less than about 0.6. Author

N66-37287*# National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.

WIND-TUNNEL—FLIGHT CORRELATION OF SHOCK-INDUCED SEPARATED FLOW

Donald L. Loving Washington, NASA, Sep. 1966 11 p refs Presented at Conf. on Aircraft Aerodyn., Langley Station, Va., 23-25 May 1966 Also published in NASA-SP-124; see X66-20091 17-01

(NASA-TN-D-3580; NASA-SP-124) CFSTI: HC $1.00/MF $0.50 CSCL 01A

A preliminary study is made of the discrepancies between wind-tunnel predictions and actual flight results for conditions of supercritical separated flow. The limited results obtained for two combinations of Mach number and lift, both involving supercritical-flow separation, suggest that the problem is related to Reynolds number and that an improvement in the correlation might be obtained by fixing the transition on a model so as to produce a relative boundary-layer thickness at the trailing edge comparable to that calculated to exist in flight. The need for continued research is indicated. Author

N66-37300*# National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.

EFFECT OF WING LEADING-EDGE SHAPE ON AERODYNAMIC CHARACTERISTICS OF A 67° SWEPT WING-BODY MODEL AT MACH 150 TO 4.63

Robert G. Kyle and Maurice O. Feryn Washington, NASA, Oct. 1966 28 p refs

(NASA-TN-D-3634) CFSTI: HC $1.00/MF $0.50 CSCL 01A

An investigation was made to determine the effects of wing leading-edge shape on the stability characteristics of a 67° swept wing-body model. Three leading-edge shapes were tested: a sharp wedge section, a slightly rounded section, and a relatively blunt section. Tests were performed at angles of attack from about −4° to 10°, at angles of sideslip from about −4° to 6°, and at a Reynolds number per foot of 3.0×10^6 (9.84×10^6 per meter). The results of this investigation indicate that increasing leading-edge bluntness increases the effective dihedral for wings with subsonic leading edges and reduces the effective dihedral for wings with supersonic leading edges. Increasing leading-edge bluntness has little effect on the longitudinal aerodynamic characteristics, other than to increase the minimum drag coefficient and to reduce the lift-drag ratio. Author

N66-37301*# National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.

HEAT-TRANSFER AND PRESSURE DISTRIBUTIONS ON 60° AND 70° SWEPT DELTA WINGS HAVING TURBULENT BOUNDARY LAYERS

William M. Murray, Jr. and Robert L. Stallings, Jr. Washington, NASA, Oct. 1966 76 p refs

(NASA-TN-D-3644) CFSTI: HC $2.50/MF $0.75 CSCL 01A

Heat-transfer and pressure distributions were obtained on 60° and 70° swept delta wings with sharp and blunt wing leading edges in a wind tunnel. All models were tested with an artificially tripped boundary layer at Mach numbers of 2.98, 3.71, and 4.44, at nominal Reynolds numbers per meter of 9.85×10^6 and 19.7×10^6, and through an angle-of-attack range from −10° to 10°. For angles of attack from 0° to 10° (instrumentation windward) both the magnitude and distribution of heat-transfer measurements throughout the range of test conditions were generally in good agreement with turbulent flat-plate theory. Heat-transfer and pressure measurements and oil-flow photographs revealed the presence of a vortex formation over the leeward surface for Mach numbers of 2.98 and 3.71, nominal Reynolds numbers per meter of 9.85×10^6 and 19.7×10^6, and angles of attack of −5° and −10°. Throughout the range of test conditions there was no noticeable effect on either the heat transfer or pressure measurements when the leading-edge radius of both wings was increased from a sharp leading edge to a cylindrical leading edge of 0.635-centimeter radius. Author

N66-37307*# Rice Univ., Houston, Tex.

BODIES OF MAXIMUM LIFT-TO-DRAG RATIO IN HYPERSONIC FLOW

Arthur H. Lusty, Jr. and Angelo Miele 1966 39 p refs (Grant NGR-44-006-034)

(NASA-CR-78247; AAR-22) CFSTI: HC $2.00/MF $0.50 CSCL 01A

The problem of maximizing the lift-to-drag ratio of a slender, flat-top body of semicircular cross section in hypersonic flow is investigated with the indirect methods of the calculus of variations. The pressure distribution is assumed to be modified Newtonian and a constant value of the skin-friction coefficient is employed. First, unconstrained configurations are considered, and it is found that the optimum body is a half-cone whose vertex angle is unique but whose size is undetermined. The scaling factor determining the size of the body can be found providing one geometric constraint is imposed on either the length, the thickness, or the volume. Next, configurations are considered upon which two geometric constraints are imposed, that is, given thickness and length, given volume and length, and given volume and thickness. For each case, the lift-to-drag ratio parameter, the thickness ratio parameter, and the optimum shape are presented as functions of a single similarity parameter involving the two given quantities, the skin-friction coefficient, and the constant modifying the Newtonian pressure distribution. Author

N66-37345# General Electric Co., Philadelphia, Pa. Missile and Space Div.

FORCES AND MOMENTS ON THE FRONT FACE OF A BLUNT LIFTING REENTRY VEHICLE

L. Goldberg Apr. 1966 53 p refs

(R66SD21)

In order to obtain more realistic values for the aerodynamic coefficients at high altitudes, the results of a recent study of the merged viscous shock layer were analytically integrated over the blunt asymmetrical spherical nose cap. The resulting algebraic equations were evaluated over a wide range of suborbital lifting reentry conditions, including free stream Mach numbers from about ten to twenty-five, altitude and nose radius combinations governed by $10^\circ \leq Re_s < 10^{10}$ (assuming the flow remains laminar), angle of attack from zero to twenty degrees and spherical nose cap half angle from five to twenty degrees. Correlations for five different methods for calculating aerodynamic coefficients were compared. It was found that the viscous effects significantly reduce the lift coefficient at high altitudes. Thus, when one is concerned with hypersonic vehicles maneuvering at high altitudes, realistic viscous effects cannot be neglected. Author

N66-37388# Mississippi State Univ., State College. Dept. of Aerophysics.

FLIGHT TEST EVALUATION OF A DISTRIBUTED SUCTION HIGH-LIFT BOUNDARY LAYER CONTROL SYSTEM ON A MODIFIED L-19 LIAISON AIRCRAFT

Sean C. Roberts, Michael R. Smith, and David G. Clark Jun. 1966 75 p refs *Its* Aerophys. Res. Rept.-66

(Contract DA-44-177-AMC-265(T))

(USAAVLABS-TR-66-36; AD-635953) CFSTI: HC $3.00/MF $0.75

A distributed suction high-lift boundary layer control system fitted to a standard liaison L-19 aircraft increased the aircraft C_L max to 5.74 and decreased the take-off and landing distance over a 50-foot obstacle by 38 percent and 29 percent, respectively, with no increase in available power. The modified aircraft demonstrated acceptable stability, control, and handling characteristics in all flight phases, and the stalling characteristics were good, with no rolling tendency. Considerable structural modifications were necessary to obtain the above results. The small holes in the boundary layer control system operated quite successfully for a period of 5 years without clogging due to dust or rain. Author (TAB)

N66-37396# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
STRUCTURE OF THE FLOW IN RELATIVE MOTION AT THE INLET OF A CENTRIFUGAL COMPRESSOR IMPELLER
B. L. Gunbin 19 May 1966 10 p refs Transl. into ENGLISH from Energomashinostroenie (Moscow), no. 10, 1964 p 43–44
(FTD-HT-66-187; TT-66-61791; AD-635832) CFSTI: HC $1.00/MF $0.50

The results of investigating the three-dimensional flow at the inlet to the working vanes of a centrifugal compressor impeller are introduced with measurement of the parameters of flow in relative motion. Author (TAB)

N66-37418*# National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.
STUDIES OF VARIOUS FACTORS AFFECTING DRAG DUE TO LIFT AT SUBSONIC SPEEDS
William P. Henderson Washington, NASA, Oct. 1966 16 p refs
(NASA-TN-D-3584) CFSTI: HC $1.00/MF $0.50 CSCL 01A

Studies of various factors affecting the subsonic drag due to lift of thin highly swept wings indicate that wings having sharp leading edges exhibit low values of leading edge suction, and no significant change in the suction is evident with increasing Reynolds number. Wings incorporating leading edge radii exhibit 90-percent suction for Mach numbers less than 0.3 at Reynolds numbers (based on leading edge radius) above 20,000. The suction developed by highly swept wings falls off considerably with lift coefficient even at relatively high Reynolds numbers, and realistic drag estimates should include this effect. Additional systematic studies are needed to assess the effects of Mach number on leading edge suction. Author

02 AIRCRAFT

Includes fixed-wing airplanes, helicopters, gliders, balloons, ornithopters, etc; and specific types of complete aircraft (e.g., ground effect machines, STOL, and VTOL); flight tests; operating problems (e.g., sonic boom); safety and safety devices; economics; and stability and control. For basic research see: 01 Aerodynamics. For related information see also: 31 Space Vehicles; and 32 Structural Mechanics.

N66-36841# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
GALLOPING OF LANDING GEAR TROLLEYS DURING THE MOVEMENT OF THE AIRCRAFT OVER A DIRT AIRFIELD
V. S. Gozdek 13 May 1966 9 p Transl. into ENGLISH from Inzh. Zh. (USSR), v. 5, no. 4, 1965 p 743–745
(FTD-HT-66-223; TT-66-61793; AD-635834) CFSTI: HC $1.00/MF $0.50

An analysis is made of the intensive trolley oscillations of aircraft landing gear which occur during landing and takeoff on dirt airfields. Motion equations are derived which describe these oscillations. It is shown that the trolley can be stabilized at any speed by placing a damper on its axles with a resistance coefficient of 1620 n m sec. R.N.A.

N66-36850*# National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.
A FLIGHT STUDY WITH A LARGE HELICOPTER SHOWING TRENDS OF LATERAL AND LONGITUDINAL CONTROL RESPONSE WITH SIZE
Robert J. Tapscott and Robert W. Sommer Washington, NASA, Sep. 1966 12 p refs
(NASA-TN-D-3600) CFSTI: HC $1.00/MF $0.50 CSCL 01D

A flight study was undertaken with a large single-rotor helicopter in an effort to establish possible effects of vehicle size on minimum acceptable control response. Test results for the pitching and rolling axes indicate that control sensitivity and angular velocity damping characteristics which provided acceptable maneuvering capability, in general, tend to confirm the validity of the reduction of these parameters with increase in vehicle size indicated by the established flying-qualities criteria. The test results show the need for considering the damping in combination with the control sensitivity when control-response criteria are applied for design purposes or when pilot's opinions are used to determine minimum acceptable response characteristics for VTOL vehicles. Author

N66-36828# David Taylor Model Basin, Washington, D. C.
SOME DESIGN PRINCIPLES OF GROUND EFFECT MACHINES. SECTION C: INTERNAL AERODYNAMICS
Harvey R. Chaplin and Allen G. Ford Apr. 1966 31 p
(DTMB-2121C; DTMB-AERO-1100C; AD-636089) CFSTI: HC $2.00/MF $0.50

The power dissipated through losses in the inlet compressor-ducting system is discussed. A simple illustrative derivation of the characteristics of a hypothetical compressor is carried out. These characteristics are then used to illustrate the construction of combined internal characteristics charts. The dominant influence of the air gap area in determining the necessary size of the compressors is emphasized. Author (TAB)

N66-37032*# National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.
STATIC AND DYNAMIC LONGITUDINAL STABILITY DERIVATIVES OF A POWERED 1/8-SCALE MODEL OF A TILT-WING V/STOL TRANSPORT
Joseph R. Chambers and Sue B. Grafton Washington, D. C., Sep. 1966 54 p refs
(NASA-TN-D-3591) CFSTI: HC $2.00/MF $0.50 CSCL 01C

Static and oscillatory force tests were conducted to determine the power-on longitudinal stability derivatives of a model of a tilt-wing V/STOL transport aircraft. The model had four propellers and the wing could be tilted from an incidence of 0° (for conventional forward propellers and the wing could be tilted from an incidence of 0° (for conventional forward flight) to 90° (for hovering flight). The investigation consisted of tests at several wing incidence angles and thrust conditions for an angle-of-attack range of ±30°. The forced oscillation equipment and dynamic data readout system are also described. The results indicate that the model was statically unstable for wing incidence angles above about 15° but was stable for lower angles. The model had positive damping in pitch (negative values of the damping-in-pitch parameter $M_{\dot{\alpha}}+M_{\dot{w}/U}$) throughout the conditions investigated. Author

N66-37130*# Israel Program for Scientific Translations, Ltd., Jerusalem.
K. E. TSIOLKOVSKII (THE CHARACTER OF HIS DISCOVERIES AND HIS CREATIVE MANNER) [MSYLI O K. E. TSIOLKOVSKOM (KHARAKTERISTIKA OTKRYTII I TVORCHESKOGO STILYA)]
A. A. Kosmodem'yanskii *In its* Soviet Rocketry 1966 p 69–84 refs (See N66-37126 22-28) CFSTI: HC $3.75/MF $1.25

In the biographical data presented, emphasis is focused on Tsiolkovskii's scientific activities in the areas of aerodynamics, the theory of aviation, rocket dynamics, the theory of

space travel, geophysics, and biology. Most of his work on all-metal airships was carried out between 1885 and 1892, and the description and aerodynamic calculations of a streamlined airplane with light engine was published in 1894. After 1896, he systematically applied himself to the theory of rocket motion and proposed a series of designs for long-range rockets and rockets for interplanetary flight. During the 1930s he concentrated on the theory of jet airplane flight and produced his own design for a gas turbine engine. The wide range of scientific papers which he published are mentioned, and several are reviewed to show their contribution to present-day rocket technology. M.G.J.

N66-37198# Air Force Systems Command, Wright-Patterson AFB, Ohio. Fuels, Lubrications, and Hazards Branch.
RESEARCH AND TECHNOLOGY FOR AIRCRAFT FIRE PROTECTION
G. T. Beery and B. P. Botteri [1966] 19 p refs Presented at the Cornell–Guggenheim Aviation Safety Center Aircraft Fluids Fire Hazards Symp., Fort Monroe, Va., 7–8 Jun. 1966
(AFAPL-CONF-66-5; AD-635686) CFSTI: HC $1.00/MF $0.50

The development of high-performance, advanced aircraft introduces new problems in fire safety. Insufficient knowledge and experience exist to establish accurately the degree of hazard that results from such considerations as aerodynamic heating of surfaces, higher engine operating temperatures, restricted usage of compartment venting procedures, and the behavior of fuel liquids, mists, and vapors under a greater range of temperatures and pressures. Investigations of these problems as well as of the methods and materials for their solution are currently in progress. These programs include the following: (1) an investigation and analysis are underway to provide definite information on fuel system fire hazards of Mach 3 aircraft; the emphasis is on cool-flame phenomena. (2) An analysis on the safety of jet fuels has indicated no significant, operational fire-safety advantage of a lower volatility fuel such as kerosene over JP-4. (3) An analysis of the current programs by the Federal Aviation Agency and the U.S. Army on emulsified and gelled fuels indicates that the utilization of such fuels, except for specialized applications, does not appear attractive for jet operations within the U.S. Air Force although the fire safety advantages are significant. Author (TAB)

N66-37295*# National Aeronautics and Space Administration. Flight Research Center, Edwards, Calif.
LIMITED FLIGHT EVALUATION OF TACTAIR FLUID CONTROL STABILITY AUGMENTATION SAFETY SYSTEM
Charles K. Jones Washington, NASA, Jun. 1966 25 p refs
(NASA-TM-SX-1284) CFSTI: HC $1.00/MF $0.50 CSCL 01C

A limited investigation of a light-airplane stability augmentation safety system has been conducted to evaluate the system's automatic activation and recovery performance as well as autopilot capability. The results of the evaluation show that activation and recovery performance are reasonably close to the manufacturer's flight data for airspeeds to approximately 190 mph. Only recoveries from nonextreme attitudes were tested, and these were completed well within the speed and load-factor capability of the aircraft. However, the aircraft encountered a terminal spiral condition from which it would not have recovered without pilot intervention because it did not develop a sufficient rate of descent of airspeed to activate the system. If used as an autopilot, the system offers sufficient stabilization for relief of pilot workload and does not present a dangerous situation if inadvertently left on during the landing maneuver. Author

N66-37299*# National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.
THE PROBLEM OF ROUGHNESS DRAG AT SUPERSONIC SPEEDS
K. R. Czarnecki Washington, NASA, Oct. 1966 16 p refs Presented at Conf. on Aircraft Aerodyn., Langley Station, Va., 23-25 May 1966 Also published in NASA-SP-124; see X66-20041 17-01
(NASA-TN-D-3589; NASA-SP-124) CFSTI: HC $1.00/MF $0.50 CSCL 01C

An assessment was made of the problem of roughness drag at supersonic speeds. The study indicates that no reliable methods are available at present for estimating roughness drag for general shapes at supersonic speeds. It appears, however, that research on the drag of surface roughness has progressed sufficiently to indicate that the basic parameters involved can be delineated and that the overall problem of roughness drag can probably be put on a more solid theoretical foundation. Some additional experimentation is needed concerning certain parameters that have not been investigated sufficiently. From the present assessment, it is apparent that roughness drag depends on local boundary-layer characteristics and that methods for calculating these characteristics in practical-type three-dimensional flows must generally be improved; the usual procedure of calculating roughness drag on the basis of the boundary layer on a flat plate generally will not be adequate. Finally, considerably more analytical work is required to reduce the complete problem to a rational basis, and a rational basis for predicting roughness effects can greatly improve airplane performance calculations. Author

N66-37382# Army Aviation Material Labs., Fort Eustis, Va.
A FLIGHT TEST PROGRAM TO INVESTIGATE METHODS OF IMPROVING COMPOUND HELICOPTER MANEUVER CAPABILITY Summary Report, 6 Oct. 1965–25 Jan. 1966
Apr. 1966 11 p
(IR-29; AD-636732) CFSTI: HC $1.00/MF $0.50

The report summarizes the preliminary results of a flight research program conducted on the UH-2 compound helicopter for the acquisition of data relative to improving the maneuver capabilities of compound helicopters. The subject program was conducted during the period from 6 October 1965 through 25 January 1966. A total of 25 flights, involving 13.2 hours of aircraft time were conducted. Detailed results and analysis thereof will be included in the final report currently in preparation. Specifically, the program encompassed three areas of technical significance: (1) wing/rotor load sharing during development of load factor buildup in a series of programmed symmetrical pullup maneuvers; (2) evaluation of automatic rotor load reduction by collective pitch reduction as a function of increasing load factor for a series of programmed symmetrical pullup maneuvers; and (3) the use of aerodynamic control surfaces (ailerons) to augment rotor roll control power. Author (TAB)

03 AUXILIARY SYSTEMS

Includes fuel cells, energy conversion cells, and solar cells; auxiliary gas turbines; hydraulic, pneumatic and electrical systems; actuators; and inverters. For related information see also: 09 Electronic Equipment; 22 Nuclear Engineering; and 28 Propulsion Systems.

N66-36524# Michigan Univ., Ann Arbor. Dept. of Electrical Engineering.
SPACECRAFT ELECTRICAL SYSTEM—NEW CONCEPTS IN PROTECTION AND CONTROL

Thomas W. Butler, Jr. *In* Canaveral Council of Tech. Soc. 3d Space Congr. 1966 p 244–247 (See N66-36506 22-30)

The entire power system is considered in the development of more reliable circuit protection and power control in manned spacecraft electrical systems. The important parameters are identified as reliability, survivability, maintability, vulnerability, size, and weight. It is suggested that the control circuit be constructed using integrated circuits which allows for a greater number of complex logical operations performed at low signal levels. The use of a single power switch that can serve both circuit protection and switching functions is recommended for weight reduction and higher reliability. Further suggestions include the location of the display and control panels in the cabin directly within the astronaut's view, with the inputs to the control logic handled through the control panel. A simplified block diagram of the proposed system is included. N.E.N.

N66-36695*# Lockheed Missiles and Space Co., Sunnyvale, Calif.

MECHANISM FOR SPACECRAFT REFLECTANCE-DEGRADATION EXPERIMENT

E. Cornish, R. K. Kissinger, and G. P. Mc Cabe *In* JPL 1st Aerospace Mech. Symp. [1966] 11 p (See N66-36691 22-31) CFSTI: HC $7.00/MF $2.00

(Contract AF 33(615)-1577)

An instrument has been designed to expose reflective surfaces to the sun for four months in space. Solutions to design problems include a magnetic drive unit to transmit motion from an enclosed motor to the outer mechanism, a light-integrating sphere using an electronically pulsed light beam for the detection of degradation of the samples, and electronic means for repositioning samples after readout. Author

N66-36701*# Lockheed Missiles and Space Co., Sunnyvale, Calif.

SOLAR CELL GRAVITY-STABILIZATION BOOMS

Bodwell D. Osborne *In* JPL 1st Aerospace Mech. Symp. [1966] 14 p refs (See N66-36691 22-31) CFSTI: HC $7.00/MF $2.00

A combination of an expandable gravity stabilization boom with a solar cell array is described. The single module, and the system assembly and operation are outlined. Mechanical and thermal bending problems are discussed, and a simulated zero-g test is suggested. It is pointed out that the combination would reduce the number of deployable systems, lessen thermal bending, position the cells beyond the shadow areas, and eliminate the need for sun-aligning servo systems. N.E.N.

N66-36706*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.

NONMAGNETIC, EXPLOSIVE-ACTUATED INDEXING DEVICE

John P. Bavernschub, Jr. *In* JPL 1st Aerospace Mech. Symp. [1966] 11 p (See N66-36691 22-31) CFSTI: HC $7.00/MF $2.00

A nonmagnetic, explosive-actuated, indexing device was developed for a magnetometer experiment flown on the Pioneer-VI Spacecraft. Conventional indexing devices were not suitable for use in instruments designed to measure low-intensity magnetic fields. This device features an arrangement by which new explosive-piston actuators are cycled into position to provide 11 independent operations. The pistons actuate a bistable escapement which permits precisely 180-deg rotation of the magnetometer sensor. Although the device was designed for a specific purpose, it is basically a nonmagnetic stepping motor. It can be modified for other stepping increments, and more operations can be provided. Author

N66-36708*# Lockheed Missiles and Space Co., Sunnyvale, Calif.

A PYROTECHNIC SHOCK ISOLATION MECHANISM

A. L. Ikola *In* JPL 1st Aerospace Mech. Symp. [1966] 15 p (See N66-36691 22-31) CFSTI: HC $7.00/MF $2.00

A pyrotechnic shock mount for protecting equipment is discussed. The shock environment and measurement are mentioned, and an approach to the analysis problem is outlined. The mount configuration consists of two silicone rubber washers and a length of plastic shrink tubing. Heat dissipation requirements are solved by using conducting straps similar to those used with standard mount systems. Results of the test program are discussed, and the functional portion was considered to be more significant than the shock-spectrum reduction. N.E.N.

N66-36715*# Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena.

EXPLOSIVELY ACTUATED (PYROMECHANICAL) DEVICES FOR SPACECRAFT APPLICATIONS

A. G. Benedict *In its* 1st Aerospace Mech. Symp. [1966] 13 p ref (See N66-36691 22-31) CFSTI: HC $7.00/MF $2.00

Rough guidelines are presented for application, design, test, and economy of explosively actuated devices, emphasizing avoidance of nonanalytic devices. It is pointed out that careful attention must be paid to detail, and a list of such details is given. The goals of test programs are identified, and types of tests, test variables and sample size are discussed. Waste and fabrication costs are mentioned. N.E.N.

N66-36717*# Lockheed Missiles and Space Co., Sunnyvale, Calif.

AN EXTENDIBLE STRUCTURE FOR SOLAR ELECTRIC POWER IN SPACE

D. E. Lindberg *In* JPL 1st Aerospace Mech. Symp. [1966] 11 p (See N66-36691 22-31) CFSTI: HC $7.00/MF $2.00

Described is an extendible structure used to angularly position four planar surfaces of solar-sensitive cells for a spacecraft electric power system. It includes the system requirements, the type of mechanisms used, and the ascent support structure. Since the assembly cannot be operated in a 1-g environment without support, a description of the equipment used for ground test is also included. Author

N66-37018# United Kingdom Atomic Energy Authority, Harwell (England). Research Group.

ELECTROCHEMICAL CONVERTERS OF NUCLEAR ENERGY

G. Grueneberg Feb. 1965 66 p refs Transl. into ENGLISH of Kernforschungsanlage Rept. Jul-144-PC, Jan. 1964

(NP-TR-1295; JUL-144-PC)

The direct conversion of nuclear energy into electricity is generally restricted to purely physical methods in the literature. The information presently available on electrochemical methods is reviewed. In these processes the nuclear energy is primarily converted into chemical energy. The radiation products are used in specially adapted galvanic cells. An important example is the charging of cells with H_2–O_2 mixtures that are formed in water-moderated reactors. An estimate of the conversion efficiency of the different electrochemical methods is possible by use of the results of radiochemical investigations. The regenerative oxygen–ozone cell with an efficiency factor of 15 to 25% should be of special technical interest. The regenerative hydrogen–ferric ion cell is also competitive with physical conversion methods. The possible use of U^{235} homogeneous reactor as a galvanic cell is briefly discussed.

Author (NSA)

N66-37038*# Globe-Union, Inc., Milwaukee, Wis.
A PROGRAM TO DEVELOP A HIGH-ENERGY DENSITY PRIMARY BATTERY WITH A MINIMUM OF 200 WATT HOURS PER POUND OF TOTAL BATTERY WEIGHT Eighth Quarterly Report, 1 Apr.–30 Jun. 1966
William E. Elliott, James R. Huff, Judith L. Jamrozy, Guy D. McDonald, Gerald L. Simmons et al 15 Jul. 1966 116 p
(Contract NAS3-6015)
(NASA-CR-72040) CFSTI: HC $3.00/MF $1.00 CSCL 10C

The electrochemical characteristics of lithium in a number of electrolytes and magnesium in aluminum chloride-acetonitrile were investigated using the voltammetric sweep method. Best performance was obtained in N-nitrosodimethylamine electrolytes. Detailed studies of lithium in lithium hexafluorophosphate-N-nitrosodimethylamine (NDA) at various voltage scan rates showed two distinct oxidation processes. The first reaction is not affected by agitation and, therefore, is not affected by mass transport. The second reaction is affected by agitation and appears to be transport limited. It is postulated that initial oxidation of the lithium is followed by a lithium oxidation process requiring transport of some species to or from the electrode. Half-cell screening tests were run on lithium anodes in thirteen electrolytes to determine performance capabilities at current levels between 10ma/cm^2 and 100ma/cm^2 and to compare performance in distilled and undistilled solvents. Trends noted were better performance in electrolytes prepared from distilled solvents and the relation of solute cation size to anode polarization. Least polarization occurred with the smallest cation, lithium. Author

N66-37040*# Clevite Corp., Cleveland, Ohio. Electronic Research Div.
STUDY OF THIN FILM LARGE AREA PHOTOVOLTAIC SOLAR ENERGY CONVERTER Third Quarterly Report, 25 Apr.–24 Jul. 1966
F. A. Shirland, J. R. Hietanen, and W. K. Bower 24 Aug. 1966 24 p
(Contract NAS3-8502)
(NASA-CR-72077) CFSTI: HC $1.00/MF $0.50 CSCL 10A

Standard process plastic substrate cells were fabricated and their stability determined under various conditions of temperature and humidity. Average cell efficiency for the period was recorded at approximately 5.1% but there is some question as to the accuracy of this figure because of difficulties with calibration of the thermopile used to measure light intensity. Difficulties with the conductive coating of the plastic substrate, with adhesion of the CdS film, and with attachment of the cover plastic have been encountered and have in general been satisfactorily dealt with. A process has been developed to cover the negative electrode tab with gold plating over a copper undercoating. This has improved cell appearance and the solderability of the tab. The efforts to produce thinner CdS films which yield high efficiency cells have still not been successful. Difficulties in this area have centered around the tooling used in the vacuum evaporator to secure thinner films at higher substrate temperatures. The use of chromium as a substrate coating in place of the zinc, while yielding good low resistance electrical contacts, has not given high efficiency cells and will therefore not be evaluated further. Instead, attempts will be made to develop a copper–zinc alloy on the metallized plastic substrate. Author

N66-37088# Marine Engineering Lab., Annapolis, Md.
OPERATIONAL STUDIES OF A SODIUM AMALGAM–OXYGEN FUEL CELL PILOT PLANT
J. A. Woerner Jul. 1966 59 p refs
(MEL-7/65; AD-636164) CFSTI: HC $3.00/MF $0.75

Operational studies have been conducted on a sodium amalgam–oxygen fuel cell pilot plant in various configurations for a total of 400 hours. The pilot plant was designed by the M. W. Kellogg Company for a five-module rated power level of 5.9 kilowatts and a maximum overload capacity of 15.9 kilowatts corresponding to electrode current densities of 70 and 285 amp per sq ft, respectively. A maximum power output of 8.7 kilowatts was obtained with 5 modules at a current density of 150 amp per sq ft. A load-bank-capacity-limited output of 8.48 kw was obtained with 4 modules in series. Continual regeneration of a flowing amalgam stream by manually controlled mechanical extrusion of solid sodium was successfully accomplished over a normal 8-hour day of test operation. Pilot plant tests were terminated after 400 hours total operation because of reduced Navy interest in sodium amalgam fuel cells. Electrochemical performance of the electrodes was considered favorable. Further engineering development work on sodium amalgam regeneration and distribution is necessary to achieve an overall power plant system which will provide reasonably trouble-free operation over the life of the fuel cells. Author (TAB)

N66-37093# Air Force Systems Command, Wright-Patterson AFB, Ohio. Aerospace Power Div.
SEALED AIRCRAFT BATTERIES
R. A. Marsh [1966] 18 p refs Presented at the 20th Ann. Power Sources Conf., Atlantic City, 24–26 May 1966
(AFAPL-CONF-66-3; AD-636153) CFSTI: HC $1.00/MF $0.50

Technological advances in sealed alkaline batteries and battery charge—charge conditioning control techniques make the sealed battery system an attractive candidate for aircraft application. Forecasted major advantages of sealed battery systems over existing vented aircraft batteries are: improved flight safety, reduced maintenance, longer service life, compatibility with aircraft electrical system, and system weight reduction. Utilization of sealed-nickel–cadmium batteries for aircraft applications is considered possible by late 1968. Sealing the battery and integrating it with the aircraft electrical system introduces several major problems: compatibility with the environment and electrical system of the aircraft, providing a fast recharge capability, selecting and maintaining the proper voltage on charge, eliminating cell internal pressure buildup, developing reliable fail-safe features, and maintaining sealed operation for extended time periods. Efforts are in progress at the Air Force Aero Propulsion Laboratory to solve or to minimize these problems. The technical approaches, the progress in problem solution, and supporting technical data are reviewed. The approaches include: improvement of electrochemical performance, end-of-charge control techniques, and methods for conditioning the aircraft bus voltage for optimum battery performance. Author (TAB)

N66-37138*# Westinghouse Electric Corp., Lima, Ohio. Aerospace Electrical Div.
RESEARCH AND DEVELOPMENT PROGRAM ON MAGNETIC ELECTRICAL CONDUCTOR, ELECTRICAL INSULATION, AND BORE SEAL MATERIALS—ELECTRICAL CONDUCTOR AND ELECTRICAL INSULATION MATERIALS Topical Report
P. E. Kueser, W. S. Neff, and D. H. Lane Oct. 1964 836 p refs Prepared in part by Eitel-McCullough Corp.
(Contract NAS3-4162)
(NASA-CR-54092; WAED64.53E) CFSTI: HC $8.85/MF $4.00 CSCL 10B

The electrical, mechanical, and thermo-physical properties of conductor and insulation materials suitable for application to advanced space electric power systems are presented. Typical applications for electrical conductor and insulation materials are discussed and various materials are suggested for

these applications. Material descriptions, specimen configurations, and test procedures are defined, and test data on over 1200 specimens evaluated at elevated temperature in appropriate atmospheres such as air, inert gas, or vacuum are given. A master index of material properties in tabular and graphical form, and an extensive bibliography abstracted during the literature search phase of the study are also included. A.G.O.

N66-37173# General Motors Corp., Kokomo, Ind. Delco Radio Div.
STUDY OF GERMANIUM DEVICES FOR USE IN A THERMOPHOTOVOLTAIC CONVERTER Final Report, 1 Jul. 1965–1 Apr. 1966
D. P. Crouch and R. W. Beck Jul. 1966 103 p refs *Its* Rept.-3
(Contract DA-28-043-AMC-01420(E))
(ECOM-01420-F; AD-636249) CFSTI: HC $4.00/MF $0.75

Work was devoted to the continued development and improvement of germanium photovoltaic devices for use in a thermophotovoltaic TPV converter. This effort was divided into two broad categories. The first category encompassed experimentation attempting to optimize the electrical performance of the absorptive TPV device. The ultimate goal of this task was to maximize the power generation exhibited by the anti-reflection coated, absorptive, TPV device. The second category encompassed experimentation attempting to develop the vapor phase epitaxial technique for the deposition of germanium on germanium substrates. The ultimate goal of this task is to develop the epitaxial technique for use in the deposition of thin, heavily doped P+ layers on N-type germanium substrates for the fabrication of the non-absorptive N on P+ device structure. Author (TAB)

N66-37183# Naval Research Lab., Washington, D. C. Library Branch.
DIRECT ENERGY CONVERSION LITERATURE ABSTRACTS
Jun. 1966 122 p refs
(AD-635584) CFSTI: HC $4.00/MF $0.75

A collection of references from various sources covering the current literature on thermoelectricity, thermionic emission, photoelectric processes, magnetohydrodynamics, electrochemical processes, energy storage, and energy sources. Author (TAB)

N66-37203# Yardney Electric Corp., New York.
DEVELOPMENT OF THE HIGH RATE METAL-AIR DEPOLARIZED BATTERIES Quarterly Report No. 3, 1 Jan.–31 Mar. 1966
Allen Charkey Ft. Monmouth, N. J., Army Electron. Command, Jul. 1966 52 p
(Contract DA-28-043-AMC-01614(E))
(ECOM-01614-3; AD-635773) CFSTI: HC $3.00/MF $0.50

A study was conducted to determine the performance characteristics and operational parameters for various metal–air couples. The anode materials being examined are Al, Ba, Ca, Mg, and Zn. They must discharge efficiently from −25°F to 125°F at rates from the 30 minute to 50 hour. Bootstrap heating for a 5 cell zinc–air battery was investigated at −25°F. Useful capacity at the C/4 rate was about one half that obtained at room temperature and about double what would be obtained at −25°F without bootstrap heating. Full sized 16 ampere-hour cells were designed, fabricated and tested. The watt-hour per pound performance of the finished prototype was in excess of 100 watt-hrs/lb. At the 1C discharge rate. A magnesium–air system of high efficiency was developed. The improvement was obtained by using sodium and lithium perchlorate instead of magnesium perchlorate electrolyte. Also, a eutectic solution of these two perchlorate salts gave acceptable performance down to −15°F. Aluminum–air cells were studied in a free rather than an immobilized electrolyte system. The best performance was obtained in an electrolyte consisting of 20% KOH and 10% NaCl saturated with ZnO. Calcium anode behavior was studied in the polarization cell and in working calcium–air cells, the work quarter consisted of finding an electrolyte which was compatible with both the anode and cathode. Author (TAB)

N66-37213*# Radio Corp. of America, Mountaintop, Pa. Industrial Tube and Semiconductor Div.
MATERIALS DEVELOPMENT FOR SOLAR CELL APPLICATIONS Final Report, 1 Jun. 1965–31 May 1966
A. R. Topfer 25 Jun. 1966 78 p refs
(NASA-CR-78132) CFSTI: HC $3.00/MF $0.75 CSCL 10A

Silicon containing lithium as an impurity to interact with radiation damage centers was investigated. Solar cells having the n-on-p as well as p-on-n structures were prepared and radiation tested. Prototype p-on-n cells having lithium in concentrations of 5×10^{17} atoms/cc in the n-range have shown improved resistance to high energy electron bombardment. At a dosage of 10^{15} 1 MeV electrons/cm^2 as high as 93% of the pre-irradiated short-circuit current was retained. A second material investigated was aluminum antimonide. The zinc and cadmium diffused p-on-n structure investigated resulted in cells having efficiencies limited to about 1%, air mass one. It was concluded that suitably formed junctions less than 1 micron deep would be required for high conversion efficiencies. However, this was too shallow to be achieved with sufficiently high doping concentrations using either zinc or cadmium. Various mathematical representations of the processing and irradiation effects permitted defining the range of processing variables necessary to give required characteristics and predicted post-irradiation performance of the cells. Author

N66-37262# Yardney Electric Corp., New York.
DEVELOPMENT OF THE SEALED ZINC-SILVER OXIDE SECONDARY BATTERY SYSTEM Final Report, 1 Jul. 1963–30 Jun. 1965
Martin Sulkes Ft. Monmouth, N. J., Army Electron. Command, Jul. 1966 176 p refs *Its* Rept.-8
(Contract DA-36-039-AMC-02238(E))
(ECOM-02238-F; AD-635776) CFSTI: HC $5.00/MF $1.00

The reaction between Zn and Oxygen was investigated during overcharge and on stand. The electrolyte level and the type of separator used in cells were the most important factors in the reaction rate. Investigation of the AgO–Ag_2O hydrogen reaction showed that the rate increased with temperature, potential, the addition of Pd to the Ag and the mobility of the electrolyte. Sealed AgZn cells may be over discharged at the C/4 rate without developing excessive pressure. Electrochemically inactive or non-dischargeable zinc reacts with the oxygen generated during reversal. Physical, chemical, and electrical properties are presented for many separator and interseparator materials. Several inorganic separator materials were evaluated. Of the group, only S5520 warrants further testing. Evaluation cycling and cycle life data were obtained for 244 sealed silver zinc cells. The best results, up to 316-621/2% depth of discharge cycles, were obtained from a cell with a 62% porous positive electrode, teflon binder, 2% HgO and 1% emulphogene-BC 840 in the negative electrode, 42% KOH, and a separator consisting of 1 turn pellon 6/5T C19(300). Another separator system of interest consists of 1 turn pellon 6/1T 2.2XH/2T FSC. Twenty-five 41 AH silver–zinc cells were sealed in stainless steel cans. TAB

N66-37279*# Radio Corp. of America, Princeton, N. J. Astro-Electronics Div.
NIMBUS-B SOLAR-CONVERSION POWER SUPPLY SUBSYSTEM Quarterly Technical Report No. 3, Mar.–May 1966

8 Jul. 1966 234 p refs
(Contract NAS5-9668)
(NASA-CR-78279; AED-R-2994) CFSTI: HC $3.75/MF $1.50 CSCL 10A

A detailed electrical definition of some power subsystem components is presented, and power subsystem operation during critical performance periods is discussed. Data are tabulated on the conversion power supply subsystem performance during launch mode with 115-watt regulated bus load and seven battery modules. The telemetry characteristics are listed, and summaries are provided on power dissipation in electronics module, battery module, power supply subsystem, and power supply subsystem with auxiliary loads. Shunt loss currents in electronics and battery modules are considered. The parameters and diode ratings affecting the choice of a suitable battery discharge diode are given, and breadboard tests of the modified regulated bus comparator are reported. The current-limited pulse width modulated regulator circuit is described, and operation and performance data are discussed. A layout of the proposed electronics module is shown. Technical studies on the battery module included environmental tests, and structural and thermal analyses. Ground checkout equipment and test documentation are outlined, and engineering reliability criteria are delineated. M.G.J.

N66-37294*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
ANALYSIS OF SOLAR THERMIONIC CONVERSION SYSTEMS OPERATING IN THE RANGE OF 1.0 TO 0.1 ASTRONOMICAL UNIT
William J. Bifano Washington, NASA, Oct. 1966 11 p refs
(NASA-TM-X-1262) CFSTI: HC $1.00/MF $0.50 CSCL 10A

An analysis of solar thermionic conversion systems is presented for mission design points ranging from 1 AU (earth) to 0.1 AU. Performance is based on a four-converter generator-solar concentrator system sized to produce 200 W of electrical power at design point. Solar flux regulating systems are not included in this evaluation; however, direct control of the diode cesium reservoir temperature and electrical load resistance is considered as a means of controlling power output. Results indicate thermionic system specific weights of between 20 and 100 pounds per kilowatt electric (9.1 and 45.4 kilograms per kilowatt electric) for the 0.1 to 1.0 AU range. Without thermal flux control, however, a large variation in output power occurs as the system moves from the earth toward the sun. Author

N66-37303*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
EFFECT OF MOISTURE ON CADMIUM SULFIDE SOLAR CELLS
Adolph E. Spakowski, Ferdinand L. Acampora, and Russell E. Hart, Jr. Washington, NASA, Oct. 1966 16 p refs
(NASA-TN-D-3663) CFSTI: HC $1.00/MF $0.50 CSCL 10A

The effect of moisture on the stability of thin-film cadmium sulfide cells was studied. The observed changes in the photovoltaic output and spectral response were indicative of performance loss. Cells made with Capran adhesive were degraded at rates directly proportional to the amount of moisture present. Cells in humidities near 100 percent suffered total loss of performance in a few days, whereas in humidities below 50 percent the loss was about 1 percent a day. In either case the mechanism appeared to be similar. Water permeated the plastic covering of the cell and was adsorbed in the junction region, and thus the number of traps which acted as recombination centers was increased. Less current was then collected by the grid and the performance consequently declined. The degradation of cells that lost less than 50 percent of their original performance was reversible and could be restored by heating in a vacuum for several hours. These cells had a loss in short-circuit current with little change in the diode characteristics. An irreversible degradation set in when the cells lost more than 50 percent power. These latter cells were distinguished by increased series resistance and a deterioration of the diode characteristics. To avoid moisture degradation, the hygroscopic Capran adhesive was replaced with epoxy resin to encapsulate cells with apparent success. Author

N66-37408*# Monsanto Research Corp., Everett, Mass. Boston Lab.
DEVELOPMENT OF THE DRY TAPE BATTERY CONCEPT Quarterly Report No. 4, 9 Mar.–9 Jun. 1966
John S. Driscoll and David L. Williams 2 Aug. 1966 69 p
(Contract NAS3-7624)
(NASA-CR-54771; MRB5010Q4) CFSTI: HC $2.50/MF $0.75 CSCL 10C

The aqueous static test method was changed from current to voltage regulation, which more closely approximates the conditions in the dynamic tests. Electrolyte studies indicated that it is the amount of water, not acid, which limits the cathode reaction. Electrolyte added through the anode was utilized more efficiently than that added through the cathode mix. The cathode mix composition was varied, and it was found that $AlCl_3$ and $MgBr_2$ increased wetting properties and that paper pulp, replacing carbon fibers, increased cell performance. Energy densities up to 88 watt-hr/lb were obtained in static tests with $Mg/MgBr_2$/ACL-85 cells run at 2.0 volts and 0.11 amp/in^2. Nonaqeuous experiments in $LiClO_4$-methyl formate electrolyte showed ACL-70 to be a better depolarizer than ACL-85 or CuF_2. Energy densities in the Li/$LiClO_4$(MF)/ACL-70 electrolyte system were improved by reduction of carbon black in the cathode mix. An energy density of 144 watt-hr/lb was obtained from the Li/ACL-70 system. N.E.N.

N66-37419*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
APOLLO FUEL-CELL CONDENSER HEAT-TRANSFER TESTS
Michael B. Weinstein Washington, NASA, Oct. 1966 31 p refs
(NASA-TM-X-1290) CFSTI: HC $1.00/MF $0.50 CSCL 10A

An experimental evaluation of the Apollo fuel-cell condenser showed that, in the expected region of condenser operation, the coolant temperature needed to condense the correct amount of water decreases linearly with increasing fuel-cell waste heat production. It was also found that, in this operating region, the overall condenser heat-transfer coefficient is approximately constant at 42.5 Btu per square foot per hour per °F. Author

N66-37423# Library of Congress, Washington, D. C. Aerospace Technology Div.
POWER CONDITIONING DEVICES—ANALYTICAL SURVEY Surveys of Foreign Scientific and Technical Literature
Joseph Podoski 28 Jun. 1966 177 p refs
(ATD-66-82)

This analytical survey, based on Soviet open sources published 1957–1965, deals with Soviet research and development efforts in the field of power-conditioning devices for aerospace vehicles. A survey and discussion of developments in power conditioning technology includes rotary electromechanical converters and static converters. A bibliography for both the abstracted and the translated articles is presented. Data on aircraft power-conditioning equipment have been included since most practical experience in dynamic and static

conversion equipment for aerospace applications is patterned after that used in aircraft. The report also contains information on other types of power conditioning equipment which by their size, weight, electrical characteristics, reliability, and environmental parameters would satisfy the requirements for aerospace applications. Each section of the report provides general information, descriptions, and illustrations of the particular class of equipment. The basic information is followed by specific details on construction, theory, regulation, control, new developments, research, testing, and design. Author

N66-37513# Royal Aircraft Establishment, Farnborough (England).
A LIGHTWEIGHT, FOUR-CHANNEL, AIRCRAFT ELECTRICAL SYSTEM USING CHANGEOVER CONTACTORS
R. L. A. Mc Kenzie and R. F. Sims Mar. 1966 18 p refs
(RAE-TR-66097) CFSTI: HC $1.00/MF $0.50

It has been shown that a simple and reliable aircraft electrical system, having very brief periods of disturbance under fault conditions, can be provided with two generating channels and normally closed changeover contactors. A four-channel system may comprise two such subsystems and, if the maximum load may be divided into six equal parts, the total generating capacity may be reduced to four thirds of the maximum load by using two auxiliary busbars transferable between the subsystems. There is no loss of load with one generator failure. Such a system has been set up and demonstrated in the laboratory. Author (ESRO)

N66-37530# European Organization for Nuclear Research, Geneva (Switzerland).
THE 150 KJ CAPACITOR BANK FOR THE MAGNETIC HORN
M. Giesch and S. van der Meer 6 Apr. 1966 19 p refs
(CERN-66-16; PS-5422)

The construction and operation of the pulsed power supply of the magnetic horn, a 150 kJ capacitor bank is described below. It has worked satisfactorily for more than 3 million CPS cycles during the CERN Neutrino Experiment. Author

N66-37541*# Marine Engineering Lab., Annapolis, MD.
NICKEL-CADMIUM BATTERY RECONDITIONER
Floyd E. Ford Aug. 1966 40 p ref
(NASA Order S-12730-G)
(NASA-CR-78363; MEL-183/66) CFSTI: HC $2.00/MF $0.50 CSCL 10C

A device has been designed for automatically reconditioning a nickel-cadmium battery. Individual cell voltage detectors and/or a battery terminal voltage are utilized to determine when reconditioning is necessary. Reconditioning is accomplished by discharging each cell to nearly 0 volts, then recharging the battery at a small current. Controlled discharge of the battery is accomplished by individual cell shunting transistors and a battery current shunt transistor. Cell reversal is prevented by cutting off the battery dump current when a cell voltage reaches a low limit. Author

N66-37576*# Alabama Univ., University. Bureau of Engineering Research.
STUDY OF THE STABILITY OF THE S-IC OPEN-LOOP PROPELLANT-HYDRAULIC SYSTEM Final Report, Jul. 26, 1964-Jul. 26, 1966
Dennis N. Osteen, William C. Stapleton, Jr., and Erwin A. Reinhard Aug. 1966 86 p refs
(Contract NAS8-11341)
(NASA-CR-78391) CFSTI: HC $3.00/MF $0.75 CSCL 13G

An analysis of the investigation of the flexible hose sections of the fluid lines is presented. From this analysis it is recommended that the maximum lengths of all flexible hoses be evaluated in terms of the critical pressure leading to buckling, and that the proof pressure test be re-examined to reduce this pressure to 10 to 20% above nominal operating pressure. The derivation of an analog simulation for this study is discussed, and the stability and performance study conducted using this analog model is also described. H.S.W.

04 BIOSCIENCES

Includes aerospace medicine, exobiology, radiation effects on biological systems; physiological and psychological factors. For related information see also: 05 Biotechnology.

N66-38427*# New York Academy of Sciences, N. Y.
HUMAN ECOLOGY IN SPACE FLIGHT, VOLUME I
Doris Howes Calloway, ed. 1966 308 p refs Proc. of the 1st Intern. Interdisciplinary Conf., Princeton, N. J., 13-16 Oct. 1963; sponsored in part by ONR
(NASA Order R-144)
(NASA-CR-77922) CFSTI: HC $7.00/MF $1.75 CSCL 06K

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N66-38428*# New York Academy of Sciences, N. Y.
CABIN ATMOSPHERE
Arthur Du Bois (Pennsylvania Univ.) *In its* Human Ecol. in Space Flight, Vol. I 1966 p 9-81 refs (See N66-36427 22-04) CFSTI: HC $7.00/MF $1.75

The composition, partial pressures, and total pressures of the gases within a manned space flight cabin atmosphere are discussed. Problems concerning: (1) bends, (2) oxygen toxicity (at the cellular level), (3) atelectasis due to absorption of gas in the lungs, (4) acceleration effects on the lungs, (5) instrument cooling effects and fire hazard, and (6) the CO_2 level allowable in the capsule are considered. Comparisons between gaseous concentrations and pressures used by the U.S. and U.S.S.R. in the cabins are made, and the implications are discussed. L.S.

N66-38430*# New York Academy of Sciences, N. Y.
GRAVITY AND ACCELERATION
Hilding Bjurstedt (Karolinska Inst.) *In its* Human Ecol. in Space Flight, Vol. I 1966 p 120-204 refs (See N66-36427 22-04) CFSTI: HC $7.00/MF $1.75

The effects of both high and low G forces, which occur in the launch and reentry phases of space flight, on human physiological systems are discussed. The primary effects of acceleration on the systemic and pulmonary circulation, and on gas exchange in the blood are considered. Also discussed are adaptive cardiovascular responses; functional disturbances secondary to insufficient adaptation; the need for protection; and the means of protection. Data obtained from monitored human subjects in laboratory environmental stress

situations are discussed. Residual effects of atelactasis; and symptomology studies of normal and deaf students in a counterrotating room are also discussed. L.S.

N66-36431*# New York Academy of Sciences, N. Y.
RADIATION IN SPACE
William F. Neuman (Rochester Univ.) *In its* Human Ecol. in Space Flight, Vol. I 1966 p 205-242 refs (See N66-36427 22-04) CFSTI: HC $7.00/MF $1.75

A broad discussion of the galactic and solar flux radiation encountered by space flights; the earth's geomagnetic belts; and the possibility of exposure from a nuclear propulsion unit that might be part of the space vehicle system, is presented. Data from balloon flights, and satellite probes concerning the intensity of these radiations are considered. Also discussed are the radiation damage effects to biological molecules; the linear transfer of radiation; and the synergistic effect of radiation with oxygen for increased toxicity. Tentative exposure limits, based on conventional X-rays and gamma rays, are considered. L.S.

N66-36432*# New York Academy of Sciences, N. Y.
MARINE BIOLOGY, VOLUME II
Carl H. Oppenheimer, ed. 1966 388 p refs Proc. of the 2d Intern. Interdisciplinary Conf., Princeton, N. J., 21-24 Oct. 1962; sponsored in part by ONR
(NASA Order R-144)
(NASA-CR-77921) CFSTI: HC $7.00/MF $2.00 CSCL 08A

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N66-36433*# New York Academy of Sciences, N. Y.
COMPOSITION
E. Steeman Nielsen (Danish Pharm. Coll.) *In its* Marine Biol., Vol. II 1966 p 11-35 (See N66-36432 22-04) CFSTI: HC $7.00/MF $2.00

Various factors, such as temperature and pH differences, and geographical location, which influence the composition and distribution of natural phytoplankton species in separate lakes and oceans (separate ecological systems) are discussed. Problems in pinpointing the transport of species from one ecological system to the other are consideres; and chemical experimental attempts to follow the motions of the microorganisms in the particular water system are described. L.S.

N66-36434*# New York Academy of Sciences, N. Y.
LIGHT AS A CONTROLLING FACTOR
Per Halldal (Gothenborg Univ.) *In its* Marine Biol., Vol. II 1966 p 37-83 ref (See N66-36432 22 04) CFSTI: HC $7.00/MF $2.00

The role of sunlight intensity as it affects the photosynthesis of plankton organisms, and their distribution in the sea is discussed. The intensity, spectral composition, angle of penetration, and spectral portion of sunlight absorbed by the atmosphere and water systems change for a particular region as the sun traverses the sky in the course of a day. These factors control the mechanisms of pigment photosynthesis and of the motions of plankton in the waters involved. Experiments regarding the influence of light on different species of plankton organisms are discussed. L.S.

N66-36435*# New York Academy of Sciences, N. Y.
NUTRITIONAL FACTORS
M. R. Droop (Scottish Marine Biol. Assoc.) *In its* Marine Biol. vol. II 1966 p 85-112 (See N66-36432 22-04) CFSTI: HC $7.00/MF $2.00

The role of various nutritional factors in the growth mechanism, and ecological habits of algae and plankton microorganisms were investigated. Experiments in which organisms are isolated into bacteria-free culture, and then grown in media containing natural fluids, are described. In order to find out what nutrients the organism requires, substitutions of known shelf chemical are made in the media. When an organism can be cultivated indefinitely in a completely known media, the concentrations of chemical in the media make up the organisms absolute requirements. Experiments of this type are discussed. Tables listing the vitamin requirements of various algae species; and a table listing the specificity of B_{12} requiring algae toward vitamin B_{12} variants are given. Data showing vitamin influences on the growth rates of various algae are discussed. L.S.

N66-36436*# New York Academy of Sciences, N. Y.
TECHNICAL PROBLEMS IN SAMPLING
T. Braarud (Oslo Univ.) *In its* Marine Biol., Vol. II 1966 p 113-137 (See N66-36422 22-04) CFSTI: HC $7.00/MF $2.00

A pumping technique for obtaining representative samples of large bodies of seawater is described, and the system is schematically depicted. Echo sounding techniques for studying zooplankton populations and movements; and fluorescence and chemical dye staining techniques are discussed. A method to preserve the naked flagellates in a satisfactory way so that they can be estimated is needed. Also discussed are problems of receiving data, particularly tabulated data on IBM cards. L.S.

N66-36437*# New York Academy of Sciences, N. Y.
SEASONAL CYCLES AND SUCCESSION OF SOCIETIES
G. A. Riley (Yale Univ.) *In its* Marine Biol., Vol. II 1966 p 145–176 (See N66-36432 22-04) CFSTI: HC $7.00/MF $2.00

Factors that bear on the cyclic nature of the appearance and seeming disappearance of phytoplankton species are discussed. The differing periodic cycles for different species; the cell volume of a particular species (which influences the rate of sinking of the species); environmental factors such as the temperature and relative placidity of the water area; and the varying light intensity striking the water with the changing seasons, are all discussed. Also considered are the different growth rates for individual species; the methods of measurement used to collect sea water samples; and the relative importance of the data sampled. L.S.

N66-36438*# New York Academy of Sciences, N. Y.
INITIAL STOCK VERSUS INVASION, GRAZING, AND SINKING
T. Braarud (Oslo Univ.) *In its* Marine Biol., Vol. II 1966 p 177–197 (See N66-36432 22-04) CFSTI: HC $7.00/MF $2.00

The role of oceanic current systems which carry water from one area to another is considered as a major mechanism for phytoplankton invasions. Species may be picked up from coastal regions into a current and carried to great distances away. Some species from land areas may be carried along by icebergs as they break off from these land areas and melt in distant waters. Experimental methods to study these mechanisms of invasion are proposed. Also discussed are the transport of population from deep water layers up to euphotic layers by vertical mixing; and the enhancement of growth by mixing of waters rich in nutrients and scarce in individuals with waters bringing in the inoculum. The role of the initial population in an area where species growth is about to begin is also considered. L.S.

N66-36439*# New York Academy of Sciences, N. Y.
EXPERIMENTS WITHIN NATURAL AND ARTIFICIAL SOCIETIES
J. H. D. Strickland (Fisheries Res. Board of Canada) *In its* Marine Biol., Vol. II 1966 p 199–225 (See N66-36432 22-04) CFSTI: HC $7.00/MF $2.00

Sea water samples containing plankton were trapped in large translucent plastic bags, and mineralization enrichment experiments were then conducted with those closed ecological systems. The experiments gave clear differential results for different species, giving insight into the effect of nutrients on the competition of species in quasi-natural populations. The data are given in graphic form, and are discussed. The expected set of ammonia, nitrite and nitrate curves were not obtained. The amount of carbon evolved as CO_2 was much greater than the particulate matter produced. Since detritus still appeared to be present, it was concluded that the dissolved organic matter believed to be excreted by the algae was responsible for the apparent excess of CO_2. Thus, it is indicated that the oxygen minima in the oceans should not be attributed to a slow combustion of small detritus particles. Also discussed are sampling techniques in which long columns are used. L.S.

N66-36440*# New York Academy of Sciences, N. Y.
NUTRITIONAL PROBLEMS
M. R. Droop (Scottish Marine Biol. Assoc.) *In its* Marine Biol., Vol. II 1966 p 251–274 (See N66-36432 22-04) CFSTI: HC $7.00/MF $2.00

Various considerations that must be taken into account during metabolic investigations with plankton cultures are discussed. Factors considered include: (1) the effects of putting too much of an inorganic nutrient or iron into a culture, (2) increased requirements of nutrients for batch systems, (3) the dilueteness of the suspension studied, (4) pH of the solution, (5) solubilities of the cells studied and of precipitated minerals and by-products, (6) growth rate of the culture, (7) buffering of the solution, (8) rate of mineral uptake by the particular species, (9) cell weights, (10) transfer of species from a rich medium to another medium lacking a particular nutrient, (11) and percent changes in composition of off-gases evolved. L.S.

N66-36441*# New York Academy of Sciences, N. Y.
MORPHOLOGICAL AND PHYSIOLOGICAL RESPONSE OF ORGANISMS DURING LIFE CYCLES
G. E. Fogg (Westfield Coll.) *In its* Marine Biol., vol. II 1966 p 275–298 (See N66-36432 22-04) CFSTI: HC $7.00/MF $2.00

The effects of media environmental factors (such as temperature, pH, turbulence, etc.); light intensity; and nutrient and mineral diets on the structure and size of plankton microorganism culture populations, and on the metabolic paths of their enzyme systems (resulting from cell expansion), are discussed. It is noted that the fat accumulation that occurs when algal is deprived of nitrogen, may result from the fact that the enzymes affected are themselves protein which utilize nitrogen in their molecular make up. Other factors discussed include morphological changes related to the sexual life cycle; cell wall thickness changes; formation of suxospores; species stability; and influences on the enzymatic activity when iron or amino acids are introduced into the culture. L.S.

N66-36442*# New York Academy of Sciences, N. Y.
ECOLOGICAL IMPLICATIONS OF IN VIVO DATA
G. E. Hutchinson (Yale Univ.) *In its* Marine Biol., Vol. II 1966 p 299–320 (See N66-36432 22-04) CFSTI: HC $7.00/MF $2.00

The spatial limitations of bottle experiments for correctly simulating the gradients of pressure, temperature, turbulence, surface area, etc. encountered in natural large bodies of water are discussed with respect to phytoplankton enzymatic activity. Field work studies of lake water compositions, and the response of cultures from lake water placed in bottles to various nutrient additions are described. The amounts of light and heavy metals, and the salt concentration in natural water environments and in bottled samples influence enzymatic activity to a great extent. Enrichment studies are discussed. The general tendency of algae to come back to a fairly constant division rate after being moved to a different condition is illustrated by three dimensional models of Monochrysis lutheri which show the cell division rate (vertical) of the microorganism as a function of temperature and light at 10, 32, and 56 hrs growth. L.S.

N66-36443*# New York Academy of Sciences, N. Y.
CONTINUOUS CULTURE VERSUS NATURAL POPULATIONS
L. Provasoli (Haskins Labs.) *In its* Marine Biol., Vol. II 1966 p 321–335 (See N66-36432 22-04) CFSTI: HC $7.00/MF $2.00

A continuous culture laboratory apparatus, designed to bridge the gap of relating batch culture data to what is going on in the ocean, is described. A photograph, and schematic labelled diagrams of the equipment are depicted. The continuous culture technique offers a number of advantages over batch culture methods because (1) concentration-dependent

factors are controlled, (2) growth rates can be measured within short periods of time, (3) the measurement operation does not interrupt the culture regime, and (4) studies can be carried out at low cell concentrations. The last factor is particularly important in studying the ecology of phytoplankton organisms. Test runs on some cultures are described. L.S.

N66-36444*# New York Academy of Sciences, N. Y.
MARINE BIOLOGY. VOLUME III: ECOLOGY OF INVERTEBRATES
W. T. Edmondson, ed. 1966 333 p refs Proc. of the 3d Intern. Interdisciplinary Conf., Princeton, N. J., 19–22 Jan. 1964; sponsored by the Am. Inst. of Biol. Sci., ONR, and AEC
(NASA Order R-144)
(NASA-CR-77920) CFSTI: HC $7.00/MF $1.75 CSCL 06C

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9. BENTHOS W. T. Edmondson (Wash. Univ.) et al p 287–294 refs (See N66-36453 22-04)

N66-36445*# New York Academy of Sciences, N. Y.
SAMPLING ORGANISMS AND RELATED PROBLEMS
John D. H. Strickland (Calif. Univ., La Jolla) et al *In its* Marine Biol. Vol. III: Ecol. of Invertebrates 1966 p 11–68 refs (See N66-36444 22-04) CFSTI: HC $7.00/MF $1.75

Methodological techniques for determination of biomass and energy contents by calorimetry and metabolic rates are discussed. A procedure for partitioning particles into several different size categories by differential filtration is illustrated by a flow diagram. Three criteria for use in observing non-random distributions during sampling are considered, and the limitations of available collecting gear and techniques for investigating epibenthic ecology are described. Several viewpoints on the determination of the energetic content of organisms by direct calorimetry are also given. L.E.W.

N66-36446*# New York Academy of Sciences, N. Y.
FEEDING
C. Barker-Jorgensen (Copenhagen Univ.) et al *In its* Marine Biol. Vol. III: Ecol. of Invertebrates 1966 p 69–133 refs (See N66-36444 22-04) CFSTI: HC $7.00/MF $1.75

Suspension feeding, i.e., the uptake of food particles that are mostly too small to be sensed and seized individually, is discussed in relation to three main topics: the extent to which continuous feeding is characteristic of suspension feeding; the extent to which it is true that the surrounding water is transported to or through the feeding organs at rates that are independent of the quality of the particular matter in suspension in the water, and also of the quantity of the concentration and to what extent the selection of food is occurring in the various suspension feeding groups and which types of selection are realized. The feeding mechanisms in the appendicularian, Oikopleura, are considered in detail and illustrated by a series of figures and electronmicrographs. Observations on nutritional biology and its ecological consequences in the Sacoglossa are related, and its feeding apparatus is described. L.E.W.

N66-36447*# New York Academy of Sciences, N. Y.
THE QUALITY OF FOOD
Dixy Lee Ray (Wash. Univ., Seattle) *In its* Marine Biol. Vol. III: Ecol. of Invertebrates 1966 p 134–169 refs (See N66-36444 22-04) CFSTI: HC $7.00/MF $1.75

Methods of determining the nutritional value of food are discussed, including measuring the loss of a food organism in terms of what disappears from what is offered, measuring the increase in size or weight or in numbers of individuals in a population, measuring the reaction products, measuring the amount of waste material that is produced, or forming a balance between what is taken in and what is given out. An experiment is described in which two-membered aseptic cultures of prey and predator were established to define the nutritional value of single species of algae. In relation to the selection of foods experiments are reported in which small populations of copepods (Calanus hyperboreus) were set up and fed a given algae. After a month, the weight of the population and the weight of the food that the population had eaten were compared. Assimilation efficiency, gross growth efficiency, and net growth efficiency data of the Calanus hyperboreus are presented in tabular form. L.E.W.

N66-36448*# New York Academy of Sciences, N. Y.
SEASONAL ASPECTS OF FOOD RELATIONSHIPS AND BREEDING
Dixy Lee Ray (Wash. Univ., Seattle) et al *In its* Marine Biol. Vol. III: Ecol. of Invertebrates 1966 p 170–204 refs (See N66-36444 22-04) CFSTI: HC $7.00/MF $1.75

The growth of organisms as a function of temperature rather than of food is discussed, and it is pointed out that if food is not sufficiently abundant these animals (Sagitta elegans and Pseudocalanus minutus) do not grow to a smaller ultimate size but simply stop growing. Graphs illustrate the adult size of these animals in four different localities plotted against estimates of mean temperature during their development. It was demonstrated that the amount of food did not distort the pattern. An experiment is also reported on the examination of the digestion of brown algae by the purple sea urchin. The approach, consisting of weighing a fraction of the algae being eaten to get the wet–dry weight ratio and then weighing the feces as they were produced, is described in detail. Four different species of brown algae were fed to the sea urchins, but the digestibility coefficient was about 80% on one type, Macrocystis. L.E.W.

N66-36449*# New York Academy of Sciences, N. Y.
EFFECTS OF QUANTITY, QUALITY, CHANGE OF DIET AND NUTRITIONAL VALUE OF FOOD
L. Provasoli (Haskins Labs.) et al *In its* Marine Biol. Vol. III: Ecol. of Invertebrates 1966 p 205–242 refs (See N66-36444 22-04) CFSTI: HC $7.00/MF $1.75

Some fundamental questions concerning marine animals are discussed, e.g., why some animals have one-year cycles, why they copulate and spawn only in certain seasons, whether

external conditions like temperature, photoperiod, and water composition act directly on the animals or indirectly through the phytoplankton food, whose changes in species composition and quantity are governed by these ecological factors. Variation in environmental factors are considered in relation to Brachyura; results of the experiment indicated that the numbers of the intermediate states of development can differ depending on food. Effects of the diet on reproduction and life span were also covered in relation to rotifers in lakes. An examination of the data collected indicated that the reproductive rate tended to vary in concert with variations in abundance of edible algae and temperature. A linear relation was drawn between the amount of food expressed as the mean number of Pseudocalanus remaining at the end of winter and the numbers of predators remaining. The number of prey did not appear to depend on the number of predators, but was felt to be a function of other things in the lake. L.E.W.

N66-36450*# New York Academy of Sciences, N. Y.
ALGAL MUTUALISM
C. M. Yonge (Glasgow Univ.) et al *In its* Marine Biol. Vol. III: Ecol. of Invertebrates 1966 p 243–251 refs (See N66-36444 22-04) CFSTI: HC $7.00/MF $1.75

The question of imprisoned phytoplankton, or of symbiosis between unicellular algae and marine invertebrates, is discussed. Two general ways in which this association may originate are delineated: in herbivorous animals, whose normal food is algae, it is the algae which must become specialized to resist digestion by the animals; in carnivorous animals it is the animal which has to develop the capacity to take in algae and tolerate their presence in the tissues. The theory that the nutritive value of the algae to the animal is the reason for association is discarded, and it is stated that the purpose of the algae is to provide an automatic excretory system and aid in calcium deposition. L.E.W.

N66-36451*# New York Academy of Sciences, N. Y.
PLANKTON
C. M. Yonge (Glasgow Univ.) et al *In its* Marine Biol. Vol. III: Ecol. of Invertebrates 1966 p 252–267 refs (See N66-36444 22-04) CFSTI: HC $7.00/MF $1.75

Various viewpoints on grazing and exclusion of animals by overconcentration of phytoplankton are presented. Several experiments in this field are briefly discussed, including one on zooplankton exclusion by phytoplankton, in which it was felt that the evidence did not support the theory of exclusion. The molting frequency of the planktonic form Euphausia was investigated, and results indicated that the molts average out to be about 10% of the dry weight of the animal. L.E.W.

N66-36452*# New York Academy of Sciences, N. Y.
VERTICAL MIGRATION
Ian A. Mc Laren (Mc Gill Univ.) et al *In its* Marine Biol. Vol. III: Ecol. of Invertebrates 1966 p 268–286 refs (See N66-36444 22-04) CFSTI: HC $7.00/MF $1.75
(Grant PHS-NB-02841)

In relation to vertical migration, observations of Euphausia pacifica are reported. These were found in a closed situation 150 or 200 m above the area which it normally inhabits in pelagic conditions. The spectral sensitivity of E. pacifica was tested to ascertain whether there had been any adaptation in these animals and how they had adapted. A spectral sensitivity curve was determined, and it was concluded that these inshore animals are more sensitive to the light in which they are living, this greener light of greater intensity, than they are to the light in which the parent community lives. Arguments are presented, and future work is briefly outlined. L.E.W.

N66-36453*# New York Academy of Sciences, N. Y.
BENTHOS
W. T. Edmondson (Wash. Univ., Seattle) et al *In its* Marine Biol. Vol. III: Ecol. of Invertebrates 1966 p 287–294 refs (See N66-36444 22-04) CFSTI: HC $7.00/MF $1.75

Factors affecting the benthic community are briefly discussed, using a comparative ecological approach. Reference was made to concepts of species diversity. It was urged that particular attention be given to the characteristics of populations as opposed to mass extension of individual physiology, which would mean analysis of the ways in which individuals react to others, either directly or through modification of the environment. Areas in which considerable progress has been made in marine ecology are pointed out. L.E.W.

N66-36466*# National Academy of Sciences—National Research Council, Washington, D. C. Space Science Board.
BIOLOGY AND THE EXPLORATION OF MARS
Colin S. Pittendrigh, Wolf Vishniac, and J. P. T. Pearman, ed. 1966 528 p refs Rept. of Study held at Stanford Univ. and New York, 1964–Oct. 1965 *Its* Publ.-1286
(Contract NASr-239)
(NASA-CR-77938) CFSTI: HC $8.27/MF $2.75 CSCL 06C

Reports of a systematic study of the Martian surface and atmosphere, with emphasis on such problems as the recognition of living organisms, planetary observation from a distance, remote-controlled landings, manned landings, and the avoidance of contamination of other planets by earth organisms are presented. For individual titles see N66-36467–N66-36497.

N66-36467*# National Academy of Sciences—National Research Council, Washington, D. C. Space Science Board.
WHAT IS LIFE ?
Daniel Mazia (Calif. Univ., Berkeley) *In its* Biol. and the Exploration of Mars 1966 p 25–40 (See N66-36466 22-04) CFSTI: HC $8.27/MF $2.75

A discussion of the salient properties and characteristics of living organisms is presented which focuses on the nature and origin of life. Considered is the task of identifying those properties (forms, substances, and processes) that are comprehended in the idea of life. Included is an analysis of the molecular approach and the evolutionary approach to the study of life. It is surmised that the most feasible approach to the study of life is through the use of the principles of molecular biology since life is a molecular operation. S.C.W.

N66-36468*# National Academy of Sciences—National Research Council, Washington, D. C. Space Science Board.
THE ORIGIN OF LIFE
Stanley L. Miller (Calif. Univ., San Diego), and N. H. Horowitz (Calif. Inst. of Tech.) *In its* Biol. and the Exploration of Mars 1966 p 41–69 refs (See N66-36466 22-04) CFSTI: HC $8.27/MF $2.75

On the basis of contemporary views on the chemical and physical processes leading to the appearance of life on Earth, the probability of finding evidence of biological activity on Mars, is assessed. Laboratory syntheses of biologically significant compounds are also reviewed in the light of their geochemical pertinence. Based on the premise that life originated on Earth at some time in the distant past the following are considered: the nature of living matter and the properties which serve to differentiate it and inanimate matter; the chemical basis for the special properties of living matter; the chemistry of the primitive Earth and the conditions that are believed to have been present during prebiotic times; and experiments dealing with the production of biologically interesting compounds under primitive Earth conditions. S.C.W.

N66-36469*# National Academy of Sciences—National Research Council, Washington, D. C. Space Science Board.
THE SOLAR SYSTEM AS AN ABODE OF LIFE
Carl Sagan (Harvard Univ.) *In its* Biol. and the Exploration of Mars 1966 p 73–113 refs (See N66-36466 20-04) CFSTI: HC $8.27/MF $2.75

Presented is an assessment of the a priori likelihood of indigenous life on the physical environments of the moons and planets of the solar system. Considered are: Mars, Venus, satellites and asteroids, and the Jovian planets. Included is a discussion of the range of planetary parameters which are consistent with the existence of living systems, such as: temperature requirements, primary solvent systems (water), the presence of atmosphere, and carbon replacement. It is concluded that of all the possible extraterrestrial habitats within our solar system and beyond, Mars is clearly the most promising. The initiation of a comprehensive program of observation from the vicinity of the Earth, from the vicinity of Mars, and eventually from unmanned and manned vehicles on the surface of Mars; is proposed. S.C.W.

N66-36470*# National Academy of Sciences—National Research Council, Washington, D. C. Space Science Board.
BIOLOGICAL MATERIALS IN CARBONACEOUS CHONDRITES
Harold C. Urey and James R. Arnold (Calif. Univ., San Diego) *In its* Biol. and the Exploration of Mars 1966 p 115–124 refs (See N66-36466 22-04) CFSTI: HC $8.27/MF $2.75

The reported presence of organic compounds in Class I and Class II carbonaceous chondrites is discussed in terms of possible origins. Also reviewed are concepts regarding the fundamental problem of what life is and under what conditions it might have evolved. In view of the premise that the requirements for the evolution of life include the existence of liquid water and a continuous supply of energy from the Sun; Venus, the Earth, and Mars are excluded as sources of meteorites showing evidences of life. It is concluded that the carbonaceous chondrites probably originated from smaller bodies, as for example, the asteroids or the Moon. Speculation is made concerning the validity of Urey's hypothesis that life evolved on one object and contaminated for a brief period of time a more primitive object, and Urey's suggestion that the Earth was the object on which life evolved, and that the Moon may have been the primitive object contaminated by material of this nature. More extensive studies of the Moon are proposed as a possible answer to the question of the origin of carbonaceous chondrites. S.C.W.

N66-36471*# National Academy of Sciences—National Research Council, Washington, D. C. Space Science Board.
SIGNS OF LIFE: A CRITERION SYSTEM OF EXOBIOLOGY
Joshua Lederberg (Stanford Univ.) *In its* Biol. and the Exploration of Mars 1966 p 127–140 (See N66-36466 22-04) CFSTI: HC $8.27/MF $2.75

Inherent systematic problems associated with theoretical and operational methods in exobiology which are used in the experimental detection of biological activity, are reviewed. Emphasized is the lag in instrumentation development for studies on Mars and the wide range of theoretical possibilities which have not yet been narrowed by the experimental process. The development of Earth-based telescopes, the development of a Mars-orbiting observatory, and the design of a general purpose laboratory for planetary investigation in which many investigators can participate, and which has the flexibility of being readily reprogrammed in the light of new data, are proposed approaches to the systematic appraisal of spaceflight experiments. S.C.W.

N66-36472*# National Academy of Sciences—National Research Council, Washington, D. C. Space Science Board.
OPTICAL ASYMMETRY
Lubert Stryer (Stanford Univ.) *In its* Biol. and the Exploration of Mars 1966 p 141–146 refs (See N66-36466 22-04) CFSTI: HC $8.27/MF $2.75

Optical symmetry, which is characteristics of terrestrial life, is discussed in terms of its diagnostic significance to studies of life on Mars. Three hypotheses generated to explore the question of whether there can be net optical activity without life, are analyzed. It is surmised that net optical activity in the absence of life is highly improbable and that a positive finding of net optical activity would be highly suggestive of the existence of life. It is further surmised that although net optical activity might conceivably go undetected due either to inadequacies of sampling and fractionation procedures, or to limitations of instrumental sensitivity, these potential difficulties are imperfections reflecting the present state of experimental methods and are not intrinsic to the use of optical activity as a criterion of the existence of life. It is concluded that the absence of net optical activity precludes the possibility of life possessing a degree of complexity resembling ours and although the existence of primitive forms of life without optical activity is a matter of conjecture, the possibility cannot be excluded on the basis of optical rotary measurements. The further development of the rotary measurement method using chemical means is discussed. S.C.W.

N66-36473*# National Academy of Sciences—National Research Council, Washington, D. C. Space Science Board.
THE BIOCHEMISTRY OF TERRESTRIAL SOILS
A. D. Mc Laren (Calif. Univ., Berkeley) *In its* Biol. and the Exploration of Mars 1966 p 147–163 refs (See N66-36466 22-04) CFSTI: HC $8.27/MF $2.75

Special properties of terrestrial soils reviewed in relation to the problem of detecting biological activity. Primary emphasis is placed on biochemical reactions in soil and the nature of soil organic matter. Included is an analysis of ecological conditions in soil, metabolic processes, soil structure and development, enzyme action in soil, and methods for testing or distinguishing living organism and products of metabolism. S.C.W.

N66-36474*# National Academy of Sciences—National Research Council, Washington, D. C. Space Science Board.
PROPERTIES OF DESERT SOLIDS
R. E. Cameron (JPL) *In its* Biol. and the Exploration of Mars 1966 p 164–186 refs (See N66-36466 22-04) CFSTI: HC $8.27/MF $2.75

Special properties of desert soils are reviewed in relation to the problem of detecting biological activity. Considered are: moisture content, soil temperatures, gas exchange and variations in concentrations of gases in the soil atmosphere, salt and organic matter content, cation exchange capacity; buffer, pH, and Eh capacities; porosity, texture, structure, and bulk density; mineralogy and soil color, and the kinds of microorganisms that are characteristic of dessert soil ecosystems. The information presented is based primarily on investigations of soils occurring in the Great Basin, Mohave, and Colorado Deserts. Additional information is derived from soil investigations of volcanic deserts in the Kau Desert of Hawaii, the Valley of 10,000 Smokes Desert in Alaska, high altitude areas in the relatively arid White Mountains of California; and unpublished data that contains details of methods and results of desert soil investigations. Speculation is made concerning the assumption that measurements of desert soils will yield information of economic value, or that measurements obtained for typical terrestrial soils should be relied upon for purposes of testing and evaluating extraterrestrial life detection systems. S.C.W.

N66-36475*# National Academy of Sciences—National Research Council, Washington, D. C. Space Science Board.
REMOTE DETECTION OF TERRESTRIAL LIFE
Carl Sagan (Harvard Univ.) *In its* Biol. and the Exploration of Mars 1966 p 187–209 refs (See N66-36466 22-04) CFSTI: HC $8.27/MF $2.75

The feasibility of detecting intelligent life (roads, bridges, and canals) and simpler forms of life on earth from earth satellite altitudes, using optical frequency reconnaissance, near infrared reflectivity, and infrared thermal mapping techniques is discussed. Both a priori considerations, based on terrestrial ground truth, and photographs taken by meteorological satellites and high altitude aircraft showed that it is very difficult to detect life on earth by photographic reconnaissance unless the ground resolution is about 0.1 km. High reflectivities in the near-infrared are indicative of the presence of the vegetation, although not uniquely so, since many inorganic materials show similar behavior. Comparison of photographs of a body of water with vegetation along its banks, obtained in the visible, with similar photographs obtained in the infrared should show a significant reversal in relative contrasts. Thermal mapping and other infrared techniques may be useful in specifying biologically promising locales which are warmer or wetter than their surroundings. Other than high resolution (~10 m) imaging of the surface, the most reliable technique for the detection of intelligent life on earth from satellite altitudes appears to be observations of monochromatic emission in the radio frequency range. S.C.W.

N66-36476*# National Academy of Sciences—National Research Council, Washington, D. C. Space Science Board.
THE DEVELOPMENT OF RIGOROUS TESTS FOR EXTRATERRESTRIAL LIFE
Sidney W. Fox (Miami Univ.) *In its* Biol. and the Exploration of Mars 1966 p 213–228 refs (See N66-36466 22-04) CFSTI: HC $8.27/MF $2.75

Potentially useful criteria of life, the physical conditions on the earth and on Mars, and examples of the potential development of the various criteria for the detection of life on Mars are discussed. Biochemical staples, macromolecules, antigenicity, optical activity, morphological variety, organized metabolic pathways, mutability, and death are among the criteria considered. Brief mention of the appearance of such phenomena in synthetic systems produced under geologically plausible conditions is also made to provide an understanding of the need for rigorous tests. S.C.W.

N66-36477*# National Academy of Sciences—National Research Council, Washington, D. C. Space Science Board.
A MODEL OF MARTIAN ECOLOGY
Wolf Vishniac (Rochester Univ.) *In its* Biol. and the Exploration of Mars 1966 p 229–242 refs (See N66-36466 22-04) CFSTI: HC $8.27/MF $2.75

Presented is a theoretical outline of a hypothetical anaerobic ecological system that is capable of operating under presumed Martian conditions. Suggested are those possibilities for which life detection experiments should be prepared, among which are cited: (1) Instrument landings should take place in a dark area and sampling should take place during and after the wave of darkening has passed. (2) If more than one landing is feasible then light and dark areas should be compared. (3) Attempts to cultivate microorganisms should make use of sampling devices that are capable of gathering particles as large as 100μ in diameter. (4) Culture media should accommodate the major ecological niches, with allowance for halophilic organisms. S.C.W.

N66-36478*# National Academy of Sciences—National Research Council, Washington, D. C. Space Science Board.
EXOTIC BIOCHEMISTRY IN EXOBIOLOGY
George C. Pimentel (Calif. Univ., Berkeley) *In its* Biol. and the Exploration of Mars 1966 p 243–251 refs (See N66-36466 22-04) CFSTI: HC $8.27/MF $2.75

Speculative possibilities for the existence of biochemical systems radically different from the terrestrial are discussed in relation to adaptation to the environment and implications for experimental procedures for detection of life. It is concluded that no matter how exciting the prospects of discovering an exotic biochemistry, the search for life on Mars will begin with an emphasis on the search for evidence of terrestrial biochemistry. The following two principles are suggested as rigid guidlines in the quest for life on Mars: (1) The conclusion that life does not exist in a given environment cannot be established by experiments directed solely toward the biochemistry we know on earth. (2) Every set of exobiological experiments should yield some definite results that will serve to improve the next set of experiments, even if all direct tests for evidence of life are negative. S.C.W.

N66-36479*# National Academy of Sciences—National Research Council, Washington, D. C. Space Science Board.
HIGHER ORGANISMS ON MARS
Carl Sagan (Harvard Univ.) *In its* Biol. and the Exploration of Mars 1966 p 252–255 refs (See N66-36466 22-04) CFSTI: HC $8.27/MF $2.75

Presented is a brief discussion of the improbability of the existence of higher organisms on Mars. On the basis of extrapolations from terrestrial technology, it is argued that: (1) Statistically, the likelihood of an indigenous civilization on Mars seems very small; and if the putative Martians are behind us, it is most likely that they are far behind us, and have not yet achieved a technical civilization. (2) If the Martians are even slightly more advanced than we, their presence should be discernible; however, neither telescopic nor radio observations have revealed obvious signs of intelligent signals or a reworking of the Martian environment by intelligent beings. (3) An advanced Martian civilization might be expected, by this time, to have arrived on earth; however, there is no evidence for such visits. Also discussed are arguments supporting the concept of the existence of intelligent life on Mars that are based on observations of the motions of the Martian satellites, Phobos and Deimos. S.C.W.

N66-36480*# National Academy of Sciences—National Research Council, Washington, D. C. Space Science Board.
SOME TERRESTRIAL PROGRAMS
Stanley L. Miller (Calif. Univ., San Diego), George C. Pimentel (Calif. Univ., Berkeley), and Carl Sagan (Harvard Univ.) *In its* Biol. and the Exploration of Mars 1966 p 259–263 (See N66-36466 22-04) CFSTI: HC $8.27/MF $2.75

Presented is a discussion of practical means for confirming and enlarging our knowledge of Mars by laboratory work and astronomical observation. Included are suggestions for Earth-based research in prebiological chemistry, laboratory programs in support of a search for exotic biochemistries; and the use of terrestrial, balloon, rocket-borne, and orbiting observatories in astronomical studies. S.C.W.

N66-36481*# National Academy of Sciences—National Research Council, Washington, D. C. Space Science Board.
POTENTIAL YIELDS OF BIOLOGICAL RELEVANCE FROM REMOTE INVESTIGATIONS OF MARS
Carl Sagan (Harvard Univ.) *In its* Biol. and the Exploration of Mars 1966 p 264–282 ref (See N66-36466 22-04) CFSTI: HC $8.27/MF $2.75

Scientific investigations of biological relevance that might be performed with projected Martian orbiters in the period 1969 to 1971, are discussed. Although the direct detection of life on Mars from an orbiter vehicle is considered unlikely, for experiments of biological significance, the principle advantages of a Mars orbiter are the prospects of (1) obtaining high topographical resolution; (2) observing at phase angles greater than 43°; and (3) detecting seasonal changes on Mars. Possible instrumental techniques for 1969 to 1971 Mars orbiters are also discussed. Analyzed are: ultraviolet spectroscopy and photometry, television, optical polarimetry, infrared radiometry and spectroscopy, and active and passive microwave radiometry and polarimetry. Four experimental packages for Mars orbiters are suggested and it is recommended that immediate instrument development and early near-Earth test flights with these devices be performed. Also recommended is the development of large, ground-based, phased-array deep space communication facilities, the performance of high-angular resolution ultraviolet spectroscopy of Mars from the vicinity of Earth, observations of Mars with gas cell calibration, and a search in the near infrared for molecular oxygen on Mars. S.C.W.

N66-36484*# National Academy of Sciences—National Research Council, Washington, D. C. Space Science Board.
BIOLOGICAL OBJECTIVES AND STRATEGY FOR THE DESIGN OF A SPACE VEHICLE TO BE LANDED ON MARS
Donald A. Glaser (Calif. Univ., Berkeley) *In its* Biol. and the Exploration of Mars 1966 p 325–330 (See N66-36466 22-04) CFSTI: HC $8.27/MF $2.75

An analysis of biological objectives for studies of extraterrestrial life on Mars, and instruments and measurements suggested for the use of known biochemical and biological techniques for detecting life on Mars; is presented. Suggested is the use of a compact general purpose computer aboard the spacecraft to correlate, organize, and program the sequence of experimental operations and the transmission of data to Earth. Also suggested is the establishment of large Earth-based computer facilities to increase the effective data rate from Mars to Earth. The design of the strategy of operation of the Mars spacecraft along the same general logical lines as those used for a well designed experiment in a terrestrial laboratory, is proposed; and a procedure focusing on the study of the physical, chemical, biochemical, and biological conditions on Mars, is discussed. S.C.W.

N66-36485*# National Academy of Sciences—National Research Council, Washington, D. C. Space Science Board.
THE AUTOMATED BIOLOGICAL LABORATORY
Donald A. Glaser (Calif. Univ., Berkeley), John Mc Carthy (Stanford Univ.), and Marvin Minsky (MIT) *In its* Biol. and and Exploration of Mars 1966 p 331–344 (See N66-36466 22-04) CFSTI: HC $8.27/MF $2.75

Means by which various devices can be coordinated into an automatic biological laboratory for determining whether there is life on Mars and estimating the state of its chemical evolution, are suggested. Considered are: the state-of-the-art in computer control; a simple automated laboratory and control of the laboratory from the Earth; television systems, transmission of pictures, and the problems and uses of computer picture pattern recognition; sample collection and the computer controlled hand; and the advantages and the problem of making the biological automated laboratory mobile. Research and development projects that may be undertaken in support of the automated biological laboratory are also identified. S.C.W.

N66-36486*# National Academy of Sciences—National Research Council, Washington, D. C. Space Science Board.
ANALYTICAL METHODS FOR LANDERS
Donald G. Rae, ed (Calif. Univ., Berkeley) *In its* Biol. and the Exploration of Mars 1966 p 347–426 refs (See N66-36466 22-04) CFSTI: HC $8.27/MF $2.75

Analytical techniques of potential application for biological studies of extraterrestrial life on Mars, are discussed. Analyzed are the following: separation methods and sample preparation; atomic spectroscopy; neutron activation analysis; electron and X-ray fluorescence; X-ray diffraction; sensitivity of fibers to the physical and chemical environment; gas chromatography; mass spectrometry; infrared, ultraviolet, and visible spectroscopy; fluorimetry; optical shifts in dye complexes; nuclear magnetic and electron paramagnetic resonance; colorimetry; optical microscopy; electron microscopy and electron-optical techniques; and morphological criteria for recognizing life. S.C.W.

N66-36487*# National Academy of Sciences—National Research Council, Washington, D. C. Space Science Lab.
THE USE OF MARTIAN MATERIALS IN THE SEARCH FOR MARTIAN LIFE
Alexander Rich (MIT) *In its* Biol. and the Exploration of Mars 1966 p 427–430 (See N66-36466 22-04) CFSTI: HC $8.27/MF $2.75

Experiments for the detection of life and for the chemical processing of Martian material to collect nutrients, are analyzed. It is surmised that it may be possible to detect life on Mars using chemical nutrients extracted on the planet since this type of experiment minimizes assumptions regarding the nature of Martian life, and obtains direct information regarding the chemical composition of the planet. S.C.W.

N66-36488*# National Academy of Sciences—National Research Council, Washington, D. C. Space Science Board.
THE IMPACT OF MANNED SPACEFLIGHT ON THE EXOBIOLOGY PROGRAM
N. H. Horowitz (Calif. Inst. of Tech.) *In its* Biol. and the Exploration of Mars 1966 p 433–435 (See N66-36466 22-04) CFSTI: HC $8.27/MF $2.75

The impact of manned spaceflight on the exobiology program, and problems of quarantine that might arise, are discussed. It is surmised that the possibility of manned missions to Mars has great significance for the exobiology program since it implies that Martian samples may become available for terrestrial study in the foreseeable future. The disadvantages of returning Martian samples to Earth such as the risk of contaminating Mars with terrestrial microorganisms and the risk of contaminating Earth with returned Martian organisms, are also cited. It is concluded that the exobiology program should retain enough flexibility so that it can take full advantage of new advances in the art of space flight, and that among these developments, none will be more significant than the development of the means for prolonged manned missions. S.C.W.

N66-36490*# National Academy of Sciences—National Research Council, Washington, D. C. Space Science Board.
"BACK CONTAMINATION" AND QUARANTINE PROBLEMS AND PERSPECTIVES
Allan H. Brown (Penn. Univ.) *In its* Biol. and the Exploration of Mars 1966 p 443–445 (See N66-36466 22-04) CFSTI: HC $8.27/MF $2.75

Summarized are conclusions reported at a conference on the Potential Hazards of Back Contamination from the

Planets (Space Science Board, 19 February 1965), which focused on the possibility and consequences of transferring to the Earth organisms that are indigenous to another planet or to the Earth's Moon. Various lines of reasoning which argue either for or against the seriousness of back contamination are as follows: (1) The danger of direct infection of man with resulting disease manifestations is unlikely but possible; (2) The harmful infection of terrestrial plants or animals other than man is far more likely; and (3) The introduction of nonpathogenic organisms seems more probable than that of agents that could cause disease. Protective measures recommended at the Conference include the retention of returned samples behind absolute bacteriological barriers for examination under conditions of rigid biological and chemical isolation; the development of techniques for minimizing contamination of astronauts and equipment while on the lunar or planetary surface; and the confinement of the spacecraft, astronauts, and all persons coming in contact with them for a period of strict quarantine (three weeks in the case of a Martian mission). S.C.W.

N66-36491*# National Academy of Sciences—National Research Council, Washington, D. C. Space Science Board.
STERILIZATION AND CONTAMINATION: THE NATURE OF THE PROBLEM
K. C. Atwood (Ill. Univ.) *In its* Biol. and the Exploration of Mars 1966 p 449–462 ref (See N66-36466 22-04) CFSTI: HC $8.27/MF $2.75

Presented is an assessment of the consequences of Mars contamination and a discussion of procedures that might be followed if contamination were known to have occurred. Included are data on prospects for significant contamination of Mars; the spread of contaminants; the extent to which the spread of contaminants would obfuscate scientific investigation; standards for spacecraft sterilization; sterilization methods; adjunctive strategems; and criteria for discontinuance of sterilization. S.C.W.

N66-36492*# National Academy of Sciences—National Research Council, Washington, D. C. Space Science Board.
THE OBJECTIVES AND TECHNOLOGY OF SPACECRAFT STERILIZATION
Lawrence B. Hall (NASA, Washington) *In its* Biol. and the Exploration of Mars 1966 p 463–466 (See N66-36466 22-04) CFSTI: HC $8.27/MF $2.75

Objectives and technology of spacecraft sterilization are reviewed. Summarized are efforts to develop flight hardware that will withstand the sterilizing agent employed without significant loss of reliability; reduce the biological loading of the lander to a low level during manufacture and assembly; achieve surface and internal sterilization of the completely assembled lander; and protect the spacecraft from recontamination during testing and launch. S.C.W.

N66-36493*# National Academy of Sciences—National Research Council, Washington, D. C. Space Science Board.
SPACECRAFT STERILIZATION
N. H. Horowitz (Calif. Inst. of Tech.) *In its* Biol. and the Exploration of Mars 1966 p 467–469 (See N66-36466 22-04) CFSTI: HC $8.27/MF $2.75

A preliminary attempt to assess the magnitude of risk that would be involved if interplanetary spacecraft were subjected only to ethylene oxide sterilization, is reported. Analyzed is the degree of internal contamination from bacteria on exposed surfaces and from bacteria which are sequestered within electronic or other components. Data suggest that electronic components are very clean from a bacteriological viewpoint. It was further indicated that organisms which are the most dangerous from a cosmoecological point of view are those which, being located on exposed surfaces, are most easily killed by gaseous sterilants such as ethylene oxide. These considerations suggest the possibility that reasonable sterility levels might be attained without terminal heat-sterilization of spacecraft. Cited are areas requiring further research which would allow a more thorough assessment of this possibility. S.C.W.

N66-36494*# National Academy of Sciences—National Research Council, Washington, D. C. Space Science Board.
DECONTAMINATION STANDARDS FOR MARTIAN EXPLORATION PROGRAMS
Carl Sagan and Sidney Coleman (Harvard Univ.) *In its* Biol. and the Exploration of Mars 1966 p 470–481 refs (See N66-36466 22-04) CFSTI: HC $8.27/MF $2.75

To provide a means of computing the level of spacecraft sterility as a function of some estimate of what constitutes an acceptable risk of planetary contamination, a method is proposed for quantitatively determining the probability of successfully performed biological experiments on Mars before the occurrence of biological contamination. S.C.W.

N66-36495*# National Academy of Sciences—National Research Council, Washington, D. C. Space Science Board.
THE SPECIAL PROBLEMS OF ENCAPSULATED CONTAMINANTS
Allan H. Brown (Penn. Univ.) *In its* Biol. and the Exploration of Mars 1966 p 482–484 (See N66-36466 22-04) CFSTI: HC $8.27/MF $2.75

Inherent operational problems affecting spacecraft sterilization requirements, which are posed by viable contaminants lodged within spacecraft solid materials, are discussed. Analyzed are efforts to develop sterilization procedures which would be compatible with spacecraft design requirements and which would not impose restrictions on the design of scientific experiments to be included in the mission. Sterilization of the entire spacecraft by dry heat soak and efforts to construct a fragmentation proof spacecraft which would ensure confinement of contaminants and reduce the total hazard associated with their presence, are discussed. It is surmised that the principal difficulty involved in measuring the resistance of encapsulated organisms to contemporary sterilization methods lies with the nondevelopment of a satisfactory quantitative assay method for encapsulated components. To overcome this problem, the initiation of the policy of starting with components having the lowest achievable levels of contamination; and of maintaining rigorous standards of cleanliness throughout the spacecraft assembly, is proposed. S.C.W.

N66-36519# Aeronutronic, Newport Beach, Calif.
AUTOMATIC CHEMICAL PROCESSING SYSTEMS FOR EXTRATERRESTRIAL BIOCHEMICAL INVESTIGATIONS
Donald C. Garwood and Harry A. Taussig *In* Canaveral Council of Tech. Soc. 3d Space Congr. 1966 p 185–200 refs (See N66-36506 22-30)

Mechanisms capable of automation for use in batch chemical processing of surface samples for scientific payloads were devised and tested. Elemental processing operations common to a wide variety of possible life detection and biochemical characterization experiments were identified. It was determined that one device could perform a multiplicity of analyses if it could perform a limited number of elemental processing operations. Mechanisms were then designed for performing such elemental processing operations, and a breadboard processing device was fabricated incorporating the

various processing operations, some completely automated (such as reagent metering) and others manually operated. The tremendous flexibility of the device to perform a wide variety of chemical procedures is evident. Tests of the breadboard in performing aqueous and organic extractions of soil samples indicate that completely automated, flight worthy chemical processing systems possessing great experimental flexibility are feasible and reliable. Author

N66-36520# Air Force Systems Command, Kirtland AFB, N. Mex.

AN EXPERIMENTAL APPROACH FOR DETERMINING THE SPACE RADIATION HAZARD TO MANNED SPACE FLIGHT

Dean E. Ewing *In* Canaveral Council of Tech. Soc. 3d Space Congr. 1966 p 201–205 refs (See N66-36506 22-30)

An experimental program is described which uses a multidisciplinary approach to develop a sophisticated technique for the measurement, interpretation, and evaluation of the space radiation environment and its potential danger. This many faceted program includes the particle accelerators, computer analyses, and sophisticated radiation measuring devices. The end result of this work will be a radiation monitoring system, simple and economical, with adequate readout for the astronaut in the space vehicle, as well as biologically meaningful dose, dose rate, and depth dose profile, rapidly available to the ground control facilities. Author

N66-36597# Joint Publications Research Service, Washington, D. C.

ON THE ROLE OF ELECTRICAL AND MAGNETIC FIELDS IN THE VITAL ACTIVITIES OF BIOLOGICAL SYSTEMS

L. K. Chernova *In its* Electron. Treat. of Mater., No. 3, 1965 2 Sep. 1966 p 89–96 refs (See N66-36590 22-15) CFSTI: $4.00

The role of magnetic fields as an important parameter in processes of the self-regulation and self-organization of biological systems is discussed. Various theories are proposed on the subject of cellular processes and the relation of protoplasmic polarity to electrical polarity. The concept of positive and negative feedback of self-regulating biological systems is considered. An example of positive feedback is presented in the case of a cell radiating mitogenetic (ultraviolet) rays as a result of cell division. These mitogenetic rays intensify the division of cells. The paramagnetic properties of free radicals, formed when a photon of light strikes a chloroplast, are examined. The role of electrical and magnetic fields in the circulation of blood is also considered. These studies are presented to demonstrate the need for further investigation of electrical, magnetic, and electromagnetic interactions as factors in the vital activity of organisms. S.P.

N66-36686# Joint Publications Research Service, Washington, D. C.

TRACE ELEMENTS IN EXPERIMENTAL AND CLINICAL MEDICINE

Georgiy Avksent'yevich Babenko 14 Sep. 1966 24 p refs Transl. into ENGLISH from the book "Mikroelementy v Eksperimental'-noy i Klinicheskoy Meditsine" Kiev, Zdorov'ye Publishing House p 3–18; 84–92; 182–183
(JPRS-37590; TT-66-34018) CFSTI: $1.00

CONTENTS:

1. INTRODUCTION p 1–3

2. GENERAL INFORMATION ON THE DISTRIBUTION AND BIOLOGICAL ROLE OF TRACE ELEMENTS IN THE HUMAN AND ANIMAL ORGANISMS p 4–12

3. METABOLISM OF TRACE ELEMENTS IN THE TISSUES AND ORGANS OF MAN IN DIFFERENT PHYSIOLOGICAL STATES OF THE ORGANISM (CONCLUSION) p 13–18

N66-36721# Joint Publications Research Service, Washington, D. C.

SOVIET COMMUNICATIONS RESEARCH WITH DOLPHINS

S. Osokin 13 Sep. 1966 10 p Transl. into ENGLISH from Krasnaya Zvezda (Moscow), 11 Jun. 1966 p 6
(JPRS-37559; TT-66-33987) CFSTI: HC $1.00

Various accounts of the dolphin's sympathy for man are related to show its intelligence and superiority to other species of the animal world. Exploring the dolphin's capability is mentioned with respect to its use in anti-submarine warfare. It is suggested that modern technology produce a means of communicating with these creatures. S.P.

N66-36724# Joint Publications Research Service, Washington, D. C.

SECOND ALL-UNION CONFERENCE ON AEROSPACE MEDICINE

9 Sep. 1966 21 p Transl. into ENGLISH from Med. Gazeta (Moscow), v. 29, no. 55, Jul. 1966 p 3
(JPRS-37524; TT-66-33952) CFSTI: $1.00

Psychological and biological problems encountered in interplanetary space flights are briefly discussed. Life support systems, especially those for regeneration of oxygen and water, and decomposition of CO_2 into carbon and oxygen, are considered. The effect of accelerations on the processes of intracellular metabolism is examined, and means of resistance by the organism are proposed. The psychological compatibility of the crew over long periods of time in a confining environment is investigated. Other problems reviewed are pressure chamber and high-altitude hypoxia, weightlessness and hypodynamics, and psychophysiological adaptations. S.P.

N66-36759# Joint Publications Research Service, Washington, D. C.

COORDINATION OF MOTOR AND VEGETATIVE FUNCTIONS IN MAN DURING MUSCULAR ACTIVITY

Yu. I. Dan'kov, N. V. Zimkin, and K. M. Smirnov, ed. 18 Aug. 1966 42 p refs Transl. into ENGLISH from the publ. "Koordinatsiya Dvigatel'nykh i Vegetativnykh Funktsiy Pri Myshechnoy Deyatel'nosti Cheloveka" Moscow, 1965 p 5–17, 117–133
(JPRS-37103; TT-66-33532) CFSTI: $2.00

CONTENTS:

1. CORRELATION BETWEEN MOTOR AND VEGETATIVE FUNCTIONS DURING MUSCULAR ACTIVITY N. V. Zimkin p 3–15 refs (See N66-36760 22-04)

2. PROBLEMS OF TRANSFER OF TRAINING IN MOTOR ACTS V. M. Zatsiorskiy p 16–34 (See N66-36761 22-05)

N66-36760# Joint Publications Research Service, Washington, D. C.

CORRELATION BETWEEN MOTOR AND VEGETATIVE FUNCTIONS DURING MUSCULAR ACTIVITY

N. V. Zimkin *In its* Coord. of Motor and Vegetative Functions in Man During Muscular Activity 18 Aug. 1966 p 3–15 refs (See N66-36759 22-04) CFSTI: $2.00

The problems of hypokinesia with insufficient motor activity and the variability of adaptive reactions developed in the

course of training are investigated. The influence of muscular activity on nonspecific increase in resistance to a number of adverse environmental factors is considered, and the general principles of interrelationship between various components of the motor and vegetative functions during muscular activity are discussed. It is noted that the problem of the general mechanisms and distinctions of this interrelationship is one of the most important ones in industrial and athletic physiology, and its comprehensive development will be particularly effective if in using research methods various indices of physiological functions at rest as well as during movement will be recorded simultaneously. A.G.O.

N66-36763# Eidgenossische Technische Hochschule, Zurich (Switzerland).
ON THE CONSTITUTION AND CONFIGURATION OF LAGOPODINE A, B, AND C [UEBER DIE KONSTITUTION UND KONFIGURATION DER LAGOPODINE A, B UND C]
Pietro Bollinger (Ph.D. Thesis) 1965 99 p refs In GERMAN (Rept.-3595) CFSTI: HC $3.00/MF $0.75

The following three metabolic substances were isolated from a culture filtrate of fungus Corpinus lagopus Fries: lagopodin A, $C_{15}H_{18}O_3$, lagopodin B, $C_{15}H_{18}O_4$, and lagopodin C, $C_{30}H_{34}O_8$. Chemical decomposition and numerous physical-chemical measurements of these metabolic substances established their structures as (101), (110), and (115), respectively. The possible syntheses of all three structures through biogeneses over sesquiterpene compounds were discussed. Transl. by G.G.

N66-36845# Stanford Research Inst., Menlo Park, Calif.
FALLOUT SIMULANT DEVELOPMENT: THE SORPTION REACTIONS OF CERIUM, CESIUM, RUTHENIUM, STRONTIUM, AND ZIRCONIUM-NIOBIUM
William B. Lane Nov. 1965 34 p refs
(Contract N228-(62479)65414)
(AD-635547) CFSTI: HC $2.00/MF $0.50

The report describes the preparation of synthetic fallout. Methods are discussed for simulating selected properties of radioactive fallout so that experiments can be conducted to evaluate radiological hazards. The experiments measured solubility of radionuclides which would be available to cycle in the food chains. Heating the fallout particles to high temperatures reduced the solubility of all nuclides studied. The methods described can be used by other researchers to prepare synthetic fallout with selected solubility and availability properties. Author (TAB)

N66-36854*# National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.
EFFECTS OF ACUTE AND CHRONIC HYPOHYDRATION ON TOLERANCE TO $+G_z$ ACCELERATION IN MAN. I: PHYSIOLOGICAL RESULTS
John E. Greenleaf, M. Matter, Jr., L. G. Douglas, S. A. Raymond, J. S. Bosco et al Washington, NASA, Sep. 1966 42 p refs (NASA-TM-X-1285) CFSTI: HC $2.00/MF $0.50 CSCL 06S

Two groups of male subjects were hypohydrated approximately 3.6 percent of their total body weight either by means of a sauna bath (acute group) or a 48-hour water restriction period (chronic group). Following hypohydration each group underwent four centrifugation runs at an acceleration build-up of +3.7 G/min—held at 6.0 G until blackout occurred. The results indicated (a) no significant difference in mean tolerance times between the acute and chronic group; (b) a significant decrease ($p<0.005$) in mean tolerance times between the normohydration and hypohydration groups; and (c) a significant decrease ($p<0.001$) in mean tolerance times over the four successive runs. The mechanisms of reduced tolerance to $+G_z$ acceleration when hypohydrated are complex because there was very little relationship between percent body weight loss, red cell volume, plasma volume, and total blood volume and tolerance time. The concept of free circulating water was advanced as a possible explanation for the conflicting results regarding the effects of water depletion on tolerance to $+G_z$ acceleration. Author

N66-36886# Sassari Univ. (Italy). Faculty of Sciences.
ENERGETICS TRANSFER IN THE PHOTODYNAMIC REACTIONS Final Technical Report
Leonida Santamaria 31 Oct. 1965 36 p refs
(Grant AF-EOAR-63-116)
(AFCRL-66-296; AD-632293) CFSTI: HC $2.00/MF $0.50

CONTENTS:

1. THE NATURAL PHOTODYNAMIC SENSITIVITY OF THE RETINA. RESPIRATION, GLYCOSIS AND THE "S-POTENTIALS" IN FISH RETINA L. Santamaria p 4–20 refs (See N66-36887 22-04)

2. EFFECTS OF LIGHT ON 3,4-BENZPYRENE CARCINOGENICITY L. Santamaria p 21–25 refs (See N66-36888 22-04)

3. PHOTOCHEMICAL SYNTHESIS OF AMINO ACIDS FROM PARAFORMALDEHYDE CATALYSED BY INORGANIC AGENTS L. Santamaria p 26–30 refs (See N66-36889 22-04)

N66-36887# Sassari Univ. (Italy). Faculty of Sciences.
THE NATURAL PHOTODYNAMIC SENSITIVITY OF THE RETINA. RESPIRATION, GLYCOLYSIS AND THE "S-POTENTIALS" IN FISH RETINA
Leonida Santamaria *In its* Energetics Transfer in the Photodyn. Reactions 31 Oct. 1965 p 4–20 refs (See N66-36886 22-04) CFSTI: HC $2.00/MF $0.50

The behavior of the slow changes in potentials (S-potentials) in response to light stimuli of individual cells in the retina of certain fish was investigated. The results show that the S-potentials of fish retina are dependent on relatively high concentration of oxygen, and on the physiological integrity of the receptors. Therefore, the natural photodynamic system responsible for the oxygen-dependent damage in irradiated retina should exert also a physiological activity in normal conditions, and it appears important in the process of vision. Preliminary data indicate that the light passing 380–500 mμ is active, whereas light passing 510–700 mμ is inactive in producing the oxygen-dependent damage of the retina. Author

N66-36888# Sassari Univ. (Italy). Faculty of Sciences.
EFFECTS OF LIGHT ON 3,4-BENZPYRENE CARCINOGENICITY
Leonida Santamaria *In its* Energetics Transfer in the Photodyn. Reactions 31 Oct. 1965 p 21–25 refs (See N66-36886 22-04) CFSTI: HC $2.00/MF $0.50

The long-ultraviolet irradiation on mice painted with 3,4-benzpyrene produces acceleration or inhibition of cancer induction according to the dosage of light. The 3,4-benzpyrene is carcinogenic independently of light. This is shown in three experiments carried out on 955 mice. Author

N66-36889# Sassari Univ. (Italy). Faculty of Sciences.
PHOTOCHEMICAL SYNTHESIS OF AMINO ACIDS FROM PARAFORMALDEHYDE CATALYSED BY INORGANIC AGENTS

Leonida Santamaria *In its* Energetics Transfer in the Photodyn. Reactions 31 Oct. 1965 p 26–30 refs (See N66-36886 22-04) CFSTI: HC $2.00/MF $0.50

The study by Bahadur, Ranganayaki, and Santamaria demonstrating the photochemical synthesis of amino acids in abiogenic conditions is re-examined to give further contributions to the photochemistry and photobiology in space research as well as to the problem of the origin of life. The photochemical synthesis in acqueous mixture of paraformaldehyde and inorganic catalysts under visible light occurs either in the presence or in the absence of a fixed nitrogen inorganic source. The type of amino acid produced and the rate of its formation are dependent on the inorganic catalyst employed. Author

N66-36906# School of Aerospace Medicine, Brooks AFB, Tex.

PHARMACOLOGY AND TOXICOLOGY OF PROPELLANT FUELS—BORON HYDRIDES

James H. Merritt Jun. 1966 13 p refs *Its* Rev. 3-66
(AD-636910) CFSTI: HC $1.00/MF $0.50

The effects of boron hydrides on animals and humans are described, and methods of treatment are discussed. Since boranes have strong electron-acceptor properties and are good reducing agents, they react with NH_3, organic amines, unsaturated hydrocarbons, various heterocyclic amines, and other compounds, including those of biological origin. Diborane, pentoborane, and decaborane are readily absorbed through the skin and by inhalation, and are particularly toxic to the central nervous system. Neurologic symptoms are the most prominent feature of pentaborane intoxication, while decaborane has produced performance decrements of reinforced tasks in the monkey. In addition to CNS disturbances, the boron hydrides produce cardiovascular effects and damage to both liver and kidney. The cardiovascular effects, as well as certain of the autonomic effects, are similar to those produced by reserpine. Glucose tolerance curves, similar to those in diabetes, are produced by decaborane and boron hydride derivative fuel. Therapy of boron hydride intoxication has been empirical with drugs used to control convulsions. Methylene blue, a stable oxidizing agent, has been found effective after decaborane exposure. E.A.O.

N66-36929# John B. Pierce Foundation of Connecticut, New Haven.

OXYGEN TRANSPORT THROUGH HEMOGLOBIN SOLUTIONS Final Report, Mar. 1963–Mar. 1965

Harold T. Hammel Wright-Patterson AFB, Ohio, AMRL, Feb. 1966 25 p refs
(Contract AF 33(657)-11103)
(AMRL-TR-66-19; AD-635623) CFSTI: HC $1.00/MF $0.50

Scholander discovered that the steady state flux of oxygen through a thin film of water could be enhanced many times by adding hemoglobin to the water. Several authors have ascribed this facilitated flux of oxygen to the diffusion of oxyhemoglobin down its gradient although the details of their formulations have not been rigorously supported by experimental evidence. A series of measurements of oxygen and nitrogen flux through a film of hemoglobin solution were made for which the PO_2 and PN_2 on one side were always 16.5 and 62.5 mmHg respectively while the PO_2 on the other side was increased from 0.5 to 14 mm Hg by adding increasing thicknesses of Teflon film to this side. When the facilitated oxygen flux was small, it was found to equal the calculated flux assuming that the oxygen was carried by the diffusing oxyhemoglobin and that Henry's law and the equilibrium dissociation curve for oxyhemoglobin apply at the two surfaces of the hemoglobin film. When the facilitated oxygen flux was greatest, it was found to be only one half the calculated flux, presumably because the PO_2 on the solution side of the gas-solution interface was considerably less than the 16.5 mm Hg prevailing on the gas side. Author (TAB)

N66-36937# Zaret Foundation, Inc., Scarsdale, N. Y.

OCULAR EFFECTS OF MICROWAVE RADIATION Annual Progress Report, 1 Sep. 1965–1 Jul. 1966

Milton M. Zaret [1966] 24 p
(Grant DA-MD-49-193-66-G188)
(AD-635943) CFSTI: HC $1.00/MF $0.50

The experimental data reported represents a major accomplishment in that for the frequency used, 5500 mc/sec, it was demonstrated that lens opacification was directly related to average power density irrespective of whether the energy was in a continuous or pulsed mode of emission. By using a closed waveguide system, it was possible to avoid all of the free-field variables of microwave radiation and to accurately determine the quantity of energy entering the eye. Comparison to a similar investigation at a different frequency (10, 050 mc/sec) revealed that the lenticular effects had practically the same time-power dose relationship. The findings demonstrate not only that various microwave emission factors can be segregated and controlled but also that exact time-power relationships for cataractogenesis can be determined by biological assay. Thus, with confidence in the replicability of the exposure methodology, it is planned to obtain additional data in accordance with the experimental protocol developed for this study. Author (TAB)

N66-36965# Commissariat a l'Energie Atomique, Grenoble (France). Centre d'Etudes Nucleaires.

PLATELET ENVIRONMENT: STUDY OF FACTORS II AND VII. MODIFICATIONS BROUGHT ABOUT BY X-RAYS [ATMOSPHERE PLAQUETTAIRE: ETUDE DES FACTEURS II AND VII. MODIFICATIONS APPORTEES PAR LES RAYONS X]

Daniel Hollard, Jean Darnault, Francoise Rambaud, Michel Suscillon, and Genevieve Marcille 1 Mar. 1966 8 p In FRENCH; ENGLISH Summary
(CEA-R-2953)

Factors affecting blood coagulation were studied using blood platelets exposed to various environmental factors and doses of 0 to 70,000 R X-radiation. Applications of the findings in clinical studies are discussed. NSA

N66-37041*# Stanford Research Inst., Menlo Park, Calif.

FEASIBILITY STUDY FOR THE USE OF IOPHENOXIC ACID AS A REFERENCE MARKER FOR PLASMA PROTEINS Final Report

Nicholas E. Kontaxis and C. Mitoma 25 Aug. 1966 66 p refs
(Contract NAS2-3072)
(NASA-CR-73032) CFSTI: HC $2.50/MF $0.75 CSCL 06A

Equilibrium dialysis experiments of human and bovine albumin with iophenoxic acid revealed an apparent association constant of about $10^7\ M^{-1}$ which is much higher than other small molecules interacting with albumin. Animal experiments have shown that the survival half-time of iophenoxic acid in monkeys, rabbits, and dog was 65–84, 23–32, and 28 days, respectively. This compound was preferentially bound to serum albumin, did not seem to be extensively metabolized, and there was no apparent effect on the metabolism of serum albumin. The biological half-life of serum albumin in monkeys was found to be approximately 20 days and its turnover .15–.18 g/kg/day. Iophenoxic acid seemed to be reassociated with

the new albumin molecules synthesized as others were metabolized, and equilibrated with the total exchangeable intra- and extravascular albumin pools. The total body and intravascular albumin mass as well as the intravascular volume for monkeys, rabbits and dog were measured following the injection of IPA and the values obtained were within the range of values reported by other investigators except for the total body albumin pool of rabbits. Author

N66-37042*# National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.

EFFECTS OF ACUTE AND CHRONIC HYPOHYDRATION ON TOLERANCE TO $+G_z$ ACCELERATION IN MAN. II: IMPRESSIONS OF SUBJECTS

S. A. Raymond, J. E. Greenleaf, and M. Matter, Jr. Washington, NASA, Sep. 1966 47 p refs

(NASA-TM-X-1255) CFSTI: HC $2.00/MF $0.50 CSCL 06S

The postcentrifugation comments of young male, water depleted subjects following $+G_z$ acceleration was assessed and summarized. Two methods of water depletion were utilized: a sauna bath (acute group) and 48-hour water restriction (chronic group). The acute group lost 3.4 percent of their total body weight and the chronic group, 3.8 percent. Blackout tolerances were measured following the two hypohydration (dehydration) periods and also during normohydration (ad libitum control) at an acceleration buildup of 3.7 G/min. The main conclusions based upon the subjective comments were: (1) Moderate hypohydration, both chronic and acute, is associated with tolerance decrements; (2) the decreased tolerance is traceable to increased fatigue brought about by the water deficit; (3) leg pain and cardiovascular embarrassment during acceleration is increased with hypohydration; (4) the progressive lessening of the leg pain with each succeeding run is partially attributable to muscular effort. Muscular effort increases subjective tolerance to acceleration, often restoring peripheral or central vision; and (5) subjective impressions of changes in tolerance only infrequently correspond to actual performance records. Author

N66-37053# Naval Submarine Medical Center, Groton, Conn.

SEALAB I: A PERSONAL DOCUMENTARY ACCOUNT

Robert E. Thompson 30 Mar. 1966 41 p *Its* Memo. Rept.-66-9

(AD-635656) CFSTI: HC $2.00/MF $0.50

The author was the medical officer participant in the group of four men who spent ten days in the underwater habitation designated SEALAB I in July–August 1964. This is a day by day account of the experiences and problems encountered by the author during the preparation for the experiences and problems encountered by the author during the preparation for the experiment, beginning on 28 April, and during the actual time underwater and during the ascent to the surface and the period of decompression, terminating on the first of August. This particular submarine-qualified medical officer was chosen for this assignment in the SEALAB I project because of his previous training in the fields of marine biology and diving medicine. This personal account is published at this time as a part of the record of the SEALAB series of projects, which are part of the larger Man-in-the-Sea Program. He describes what they ate, how they slept, details of their sorties into the ocean around them; problems due to contamination of their atmosphere; the fish and marine life observed through their portholes or encountered in their excursions outside the SEALAB; as well as their psychological states, their relationships with each other, and their communications with both the support personnel topside and their families at home.

Author (TAB)

N66-37065# School of Aerospace Medicine, Brooks AFB, Tex. Aerospace Medical Div.

ORAL HYGIENE PROCEDURES IN THE PRESENCE OF A "TUBE-TYPE" DIET, MARCH 1964–OCTOBER 1965

Timothy J. O'Leary, Arthur J. Stumph, Jr., and Paul V. Sundberg, Jr. May 1966 14 p refs

(SAM-TR-66-44; AD-635612) CFSTI: HC $1.00/MF $0.50

Three studies were carried out to explore the effects of a liquid 'tube-type' diet on gingival status and plaque accumulation when subjects employed (1) their usual oral hygiene procedures without a dentifrice, and (2) various proposed oral hygiene procedures without a dentifrice. The initial 35-day study evaluated changes in gingival health and plaque status that occurred when subjects employed their usual oral hygiene practices without a dentifrice. There were significant mean increases in the scores for gingival inflammation ($P<.01$) and in plaque accumulation ($P<.05$). A second study evaluated the efficiency of two proposed minimal oral hygiene procedures for 33 days. There was a statistically significant increase ($P<.01$) in gingival inflammation, but no mean increase in plaque scores. A third study evaluated the relative efficiency of three oral hygiene procedures for a 44-day period. There was no significant increase in gingival inflammation or plaque accumulation during the experimental period. Author (TAB)

N66-37067# Applied Psychological Services, Wayne, Pa. Science Center.

STUDIES INTO INFORMATION PRESENTATION THROUGH NOVEL METHODS. III: TWO-WAY INFORMATION TRANSFER THROUGH ELECTROCUTANEOUS TRANSDUCTION

M. A. Fischl, Arthur I. Siegel, and Douglas H. Mac Pherson Jul. 1966 44 p refs

(Contract DA-28-043-AMC-00186(E))

(AD-635693) CFSTI: HC $2.00/MF $0.50

After brief training in a code and orientation to the electrocutaneous transduction equipment, three two-man teams employed the code and the equipment to communicate with one another while jointly performing an experimental task. Two levels of time stress and three levels of attention sharing were imposed. Communication performance was scored as well as performance on a collateral visual monitoring task. The results indicated that: (1) reasonably precise two-way electrocutaneous information transfer had taken place, (2) communication performance was not degraded by the conditions of stress and attention-sharing, but (3) collateral task performance was degraded by stress and possibly by attention-sharing. It was concluded that the feasibility of the cutaneous sensory channel for supporting two-way information transfer in a limited vocabulary setting had been at least partially demonstrated. Some possible applications are discussed.

Author (TAB)

N66-37074# Massachusetts Inst. of Tech., Cambridge.

FREEDOM AND CONTROL: THE DILEMMA OF CREATIVITY IN THE ORGANIZATIONAL ENVIRONMENT

Harper Brown Keeler (Ph.D. Thesis) Jun. 1966 271 p refs

(AD-635261) CFSTI: HC $1.50/MF $1.50

The purpose of this study is the analysis of creativity in the context of organizations found in an advanced modern social system. The report deals with a critique of the literature related to the problems of creativity in organizations, with these criticisms in mind, the second part compares different organizations ranked by levels of creativity. Different factors of the environments (especially those relating to organizational control and feelings of individual freedom) which influence creativity levels are analyzed. Eight environments were chosen for study to include industrial labs, government labs, and academic labs. The first case study analyses the severe constraints

on creativity which can occur in an organization operated under public health regulation. Four labs that exhibit different levels of creativity are compared. Propositions are generated to explain these differences. These propositions are tested in three academic labs which are assumed to have more creative environments. The conclusions include recommendations for altering the theoretical framework offered by the literature, and recommendations for organizations wishing to foster creativity in their participants. TAB

N66-37091# Laval Univ. (Quebec).
NEUROHUMORAL CONTROL OF THYROTROPIC ACTIVITY
Final Technical Report, Oct. 1, 1963-Sep. 30, 1965
Claude Fortier [1965] 26 p refs
(Grant AF-AFOSR-511-64)
(AFOSR-66-1476; AD-636083) CFSTI: HC $1.00/MF $0.50

Studies on the levels of interaction between ACTH, TSH, corticosteroid and thyroid hormones are described.
Author (TAB)

N66-37106# Naval Radiological Defense Lab., San Francisco, Calif.
RECOVERY FROM RADIATION INJURY IN SWINE AS EVALUATED BY THE SPLIT-DOSE TECHNIQUE
D. S. Nachtney, E. John Ainsworth, and George F. Leong 18 May 1966 27 p refs
(USNRDL-TR-1025; AD-635735) CFSTI: HC $2.00/MF $0.50

With 1 Mvp X-rays, the acute LD50/30 (midline air dose) of 8–9 month old Duroc gilts was determined to be 399 R (95% confidence interval: 371–424 R). The pattern of recovery from the effects of 240 or 265 R of X-rays was studied by means of the split-dose technique, which consists of conditioning the animals with a sublethal exposure and redetermining the LD50 at various times thereafter. By this criterion, the swine had recovered from 51% of the initial injury by three days. By seven days, they appeared to have recovered from about 65% of the initial injury, but the data suggest that part of the population had recovered completely while part was still about as sensitive as at three days. By twenty days, the entire population appeared to be radioresistant: the redetermined LD50 was 164% of the LD50 of unconditioned animals. Radioresistance was also evident at 61 and 107 days: at 61 days, 734 R killed eight out of 15 animals conditioned with 265 R whereas, the same exposure killed 15 of 15 unconditioned animals; at 107 days, none of nine conditioned animals died after 399R. The pattern of systemic recovery and the period of radioresistance are not clearly reflected in the pattern of hematological changes that follow a conditioning exposure. Author (TAB)

N66-37109# Miami Valley Hospital, Dayton, Ohio. Dept. of Research.
EVALUATION OF TECHNIQUES FOR BIOASSAY OF ERYTHROPOIETIN IN SERA OF HUMANS AND ANIMALS IN AMBIENT AND HYPEROXIC ENVIRONMENTS
Bernard J. Katchman and George L. Beemsterboer Wright-Patterson AFB, Ohio, AMRL, Dec. 1965 44 p refs
(Contract AF 33(615)-1169)
(AMRL-TR-65-85; AD-635599) CFSTI: HC $2.00/MF $0.50

The regulation of erythropoiesis by blood pO_2 is of direct consequence to any evaluation of the suitability of higher than ambient O_2 partial pressures in space cabin environments. Alterations in serum erythropoiesis stimulating factor (ESF) of individuals exposed to space cabin environments for long periods of time may have clinical consequences. Four methods for the assay of serum ESF were evaluated, and of these, only the hypoxia-induced polycythemic bioassay rat proved to be sensitive enough to detect ESF in 2 ml of serum. Serum ESF is related to that fraction of a dose of Fe^{59}, injected into the bioassay rat, which appears in the red blood cells after twenty-four hours. Endogenous ESF causes Fe^{59} uptakes of 6.4±3.9%; 2 ml of human serum causes Fe^{59} uptakes of 15.4±6.8%, which are statistically significant from the controls. Variances in duplicates are such that to distinguish between two samples at the 95% confidence interval, the samples must differ from each other by about 50% in ESF content. Although statistically significant changes in blood ESF were found, both in animals and humans exposed to 100% O_2, the physiological significance of these changes is unexplained due to the paucity of data. The unique discovery that neuramin lactose, neuraminic acid, and beta-lactose stimulate Fe^{59} uptake into red blood cells would indicate that the parameters which control incorporation of iron into red blood cells need further definition. Author (TAB)

N66-37121# Joint Publications Research Service, Washington, D. C.
PHASE ANALYSIS OF CARDIAC ACTIVITY
V. A. Karpman 13 Sep. 1966 261 p refs Transl. into ENGLISH of the book "Fazovvy Analiz Serdechnoy Deyatel'nosti" Moscow, 1965 p 1–276
(JPRS-37555; TT-66-33983) CFSTI: $6.00

Dynamics of the human heart functions were studied by standardization of their main phase parameters under static and dynamic conditions; phase changes under the influence of physiological disturbances; general pathophysiological aspects of phase analysis; the syndromic nature of phase changes in physiological and clinical practice; methodology, etc. Detailed phase structures of the cardiac cycle were depicted in a physiological essay and descriptions of the various diagnostic methods and electrical recording devices as well as their particular morphological phase pattern analyses were included. G.G.

N66-37145*# Stanford Research Inst., Menlo Park, Calif.
A THEORETICAL ANALYSIS OF THE VISUAL ACCOMMODATION SYSTEM IN HUMANS
Hewitt D. Crane Washington, NASA, Sep. 1966 79 p refs
(Contract NAS2-2760)
(NASA-CR-606) CFSTI: HC $2.50/MF $0.75 CSCL 06D

This study has attempted to model the human visual-accommodation system, starting directly with the retinal image. The models that are developed are reasonably consistent with existing data and offer a certain degree of understanding of certain features of the data. The modeling is in three stages. Starting at the retina it is asked: (1) What portion of the retinal picture is involved in accommodation control, (2) How that portion of the picture is processed to derive a measure of defocus, and (3) How that signal in turn is used to control the ciliary muscles. It is tentatively concluded that the relevant portion of the retina is a central region of the fovea, having a diameter of some 30 minutes of arc, or 6 mils—the diameter of a coarse human hair. As for processing of the retinal image, it is shown how neural circuits based on lateral inhibition can yield a measure of defocus that is consistent with experimental data over several orders of magnitude of object size and illumination. It is also shown how interaction between three such overlapping receptor regions could account for certain chromatic effects in accommodation control. The case is argued for a control cycle involving a sampling of the accommodation error followed by a ballistic corrective movement. In terms of this control model the elusive lens "vibrations" appear to be no more than normal accommodation correction cycles. Apart from its role in accommodation control it is also noted how these lens vibrations could possibly increase the depth of field for strong accommodation. The models predict significant interaction between accommodation control and eye-movements. A number of experiments are proposed which would help elucidate the nature of this interaction. Author

N66-37186# Institute for Research, State College, Pa. Div. of Psychobiology.

DRUG EFFECTS UPON PERFORMANCE UNDER TASK-INDUCED STRESS

Paul M. Hurst and Marianna F. Weidner Jan. 1966 32 p refs (Contract Nonr-4423(00))

(ONR-H-66-1; AD-635947) CFSTI: HC $2.00/MF $0.50

An experiment was performed to test the interaction between drug/placebo effects and incentive conditions under task-induced stress. Sixty-three student volunteers served in a factorially designed experiment varying level of incentive, drug condition, and placebo condition (whether or not the subject was led to believe he had received a drug). All active drugs were given in disguised form. These included *d*-amphetamine sulfate (10 mg), chlordiazepoxide HCl (10 mg), and methylphenidate HCl (10 mg). Neither the incentive nor the placebo condition factor had a significant effect upon performance. *D*-amphetamine showed a significant superiority to other drug conditions early in the session. Most of this superiority derived from the high stress condition. Mood effects were also noted. Results were interpreted as favoring a mood-related component in performance enhancement rather than the psychoanalytic factor. Author (TAB)

N66-37187# School of Aerospace Medicine, Brooks AFB, Tex.

PRELIMINARY OBSERVATIONS ON TESTICULAR FUNCTION IN ROOSTERS AND MICE EXPOSED TO INCREASED PARTIAL PRESSURE OF OXYGEN, MARCH 1964–APRIL 1965

Frode Ulvedal Apr. 1966 17 p refs

(SAM-TR-66-40; AD-635611) CFSTI: HC $1.00/MF $0.50

Adult white leghorn roosters were exposed to 100% oxygen atmospheres at 258 and 380 mm Hg pressure for 31 and 22 days, respectively. A ground-level control experiment was also performed. Ejaculates were obtained twice weekly by the massage technic and the ejaculate volume, total sperm count, and sperm motility were measured. The results show that confinement to the chamber for 58 days (ground-level control experiment) and exposure to 100% oxygen at 258 mm Hg pressure for 31 days had essentially no effect on the three variables studied. The ejaculate volume, sperm motility, and total sperm count decreased significantly, however, in roosters exposed to 100% oxygen at 380 mm Hg; the decrease in the three variables occurred during the first 4 to 7 days. Otherwise, the birds remained apparently healthy throughout the experiments. Histologic examinations were made on the testes after a 30-day recovery period. Size and weight of the testes from the 380 mm Hg oxygen group were also reduced as compared to controls. Previously, the reproductive capabilities of male and female mice investigated at higher partial pressures were found to be adversely affected. Author (TAB)

N66-37208*# Illinois Univ., Urbana. Dept. of Physiology and Biophysics.

THE PHYSICAL AND CHEMICAL PROPERTIES OF HUMAN SWEAT AND FACTORS AFFECTING THE WATER BALANCE IN CONFINED SPACES Semiannual Status Report No. 2, 1 Jan.–30 Jun. 1966

Robert E. Johnson and Frederick Sargent [1966] 46 p refs (Grant NGR-14-005-050)

(NASA-CR-78121) CFSTI: HC $2.00/MF $0.50 CSCL 06P

Efforts during this period were concerned with the chemical composition of sweat compared with its osmotic pressure, the acid-base properties of sweat, and sweat viscosity and density. Sweat constituents were measured and showed the sum of anions about equal to the cations. However, the sum of all constituents did not always account for the osmotic pressure. Experiments on the acid-base properties of sweat showed that neither lactic acid-lactate nor carbonic acid-bicarbonate systems were related to changes in acidity. However, changes in ammonia were closely correlated with acidity changes. Titration curves showed four discontinuities. Fourteen amino acids were detected. Serine, alanine, and glycine were detected in amounts over 0.4 mMole/liter. The viscosity and density of sweat were compared with those of distilled water and sodium chloride solutions. The viscosity of sweat is higher than that of saline solutions of the same density, and increases with temperature while that of saline solutions decreases between 29° and 35°C. A system for measuring the secretory pressure of a single sweat gland and a routine for preparing skin to collect sweat were developed and are described. R.N.A.

N66-37236# Naval Radiological Defense Lab., San Francisco, Calif.

MEASUREMENT OF THE ANTIBODY RESPONSE BY THE ELIMINATION OF I^{131}-LABELED PROTEINS. I: THE ELIMINATION OF I^{131}-LABELED PROTEINS FROM THE BLOOD OF NORMAL MICE

Walter W. H. Weyzen and Myron S. Silverman 19 May 1966 49 p refs

(USNRDL-TR-1020; AD-635754) CFSTI: HC $4.00/MF $0.50

The effect of a number of variables on the elimination of I^{131}-labeled proteins from the blood of normal mice was studied. The purpose of these studies was to arrive at a critical evaluation of the antigen elimination technique which will be used for the measurement of the immune response in studies on the recovery from radiation injury. The method is based on the fact that the biological half-life of a protein is reduced in the presence of specific antibodies in the blood. It was found that the elimination of I^{131}-horse serum albumin in normal LAF_1 mice—under the experimental conditions employed—was not affected by the amount of protein injected or by the time of sampling. Although the degree of labeling had no effect on the half-life measured, a shift of the elimination curve was observed which was time dependent. This change was attributed to radiation damage of the protein by the radioactive label. The elimination characteristics of a number of different proteins for possible use in the immunization experiments were studied. Considerable differences were observed in the way closely related proteins were eliminated from the blood. The half-life of the albumins ranged from 13.36 hr for I^{131}-porcine serum albumin to 22.03 hr for I^{131}-dog serum albumin. Author (TAB)

N66-37237# School of Aerospace Medicine, Brooks AFB, Tex.

CARDIAC OUTPUT AND REGIONAL BLOOD FLOW IN THE ANESTHETIZED BABOON

William P. Fife May 1966 12 p refs Presented at the Intern. Symp. on the Baboon and Its Use as an Exptl. Animal (2d), San Antonio, 2 Nov. 1965

(SAM-TR-66-50; AD-635613) CFSTI: HC $1.00/MF $0.50

Cardiac output and regional blood flow measurements were made in 9 normal, anesthetized, adult baboons by the use of radioactive tracers. Essentially, the method consists of rapidly introducing a solution of rubidium (Rb^{86}) chloride into a femoral vein while serially sampling blood flow at the femoral artery. Thirty seconds after the injection of the radioactivity, the animal is sacrificed by the rapid injection of 10 cc lethol. This results in the production of a dye dilution curve which, by the employment of a modified Fick equation, provides the measurement of the cardiac output over the sampling period. It also results in the deposition of radioactive rubidium in the capillary beds of all tissues except the brain in direct proportion to the blood flow to that organ over the same time period. From this information, the percent of cardiac output to each tissue bed may be determined and, when calculated on the

basis of the cardiac output over the same period of time, actual blood flow in centimeters per minute may be obtained. By this technique, blood flow to the following tissues was obtained: heart, lungs, liver, gut, spleen, stomach, adrenals, kidneys, thyroid, omentum, skin, and skeletal muscle and bone. These data are compared with similar data for the dog and man. Author (TAB)

N66-37244# Melpar, Inc., Falls Church, Va. Research Div.
MECHANISM OF MICROBIOLOGICAL CONTAMINATION OF JET FUEL AND DEVELOPMENT OF TECHNIQUES FOR DETECTION OF MICROBIAL CONTAMINATION Semiannual Progress Report, 1 Jan.–1 Jun. 1965
Gordon C. Blanchard and Charles R. Goucher Jul. 1966 82 p refs
(Contract AF 33(657)-9186)
(AD-635929) CFSTI: HC $3.00/MF $0.75

Two methods for detecting microorganisms were examined in the light of the present understanding of the jet fuel microorganisms. One method was based on a color produced by the enzymes of the organism. This method was found suitable for the detection of organisms in the early part of their growth in fuel systems. However, the sensitivity of the method declined slightly with the age of the culture. Another detection method was devised, tested, and found to be highly sensitive and independent of the age of the culture. This detection method has two simple steps. The first step is the reaction of microbial cells with a specific metal ion; the second step is the reaction of bound metal ions with a colored reagent. The method promises to yield a simple visual readout system capable of field application. The production of compounds by microorganisms associated with aluminum corrosion was dependent on the presence of high concentrations of nitrate ion as well as on jet fuel components. A direct relationship was found between the onset time of respiratory decline and the appearance of corrosive pigments in microbial cultures oxidizing jet fuel. Author (TAB)

N66-37247# Naval Air Development Center, Johnsville, Pa. Aerospace Medical Research Dept.
PULMONARY FUNCTION IN MAN UNDER PROLONGED ACCELERATION. II: CORRELATION OF ARTERIAL BLOOD OXYGEN SATURATION WITH VENTILATION AND GAS BEING BREATHED Final Report
Frederic C. Hoppin, Jr., Raymond J. Sever, and Lloyd Hitchcock Jr., 31 Dec. 1965 23 p refs
(NADC-MR-6519; AD-636723) CFSTI: HC $1.00/MF $0.50

Arterial blood oxygen saturation was studied by ear oximetry in 8 subjects undergoing prolonged forward $+G_x$ acceleration. The effects on saturation of voluntary breathing patterns and the composition of the inspired gas were noted. Under $+4G_x$ saturation levels were stable after two minutes. The degree of unsaturation could be modified to a small extent by voluntary breathing efforts. The level of saturation reached correlated significantly with the minute volume breathed. In contrast, under $+8G_x$ saturation levels were significantly lower and were still falling after two minutes. Saturation levels were not significantly changed by voluntary breathing efforts and there was no significant correlation between level of saturation reached and minute volume breathed. Breathing of oxygen delayed the onset of arterial blood oxygen unsaturation. After two minutes under $+8G_x$, levels were 20% higher when the subjects breathed oxygen than when they breathed air. When subjects changed from air to oxygen or from oxygen to air on attaining peak acceleration, the effects of the 'prebreathed' gas were apparent for as long as two minutes, suggesting that the prebreathed gas was effectively trapped in some parts of the lung. Author (TAB)

N66-37248# School of Aerospace Medicine, Brooks AFB, Tex.
PHYSIOLOGIC EFFECTS OF AN 18-HOUR FLIGHT IN F-4C AIRCRAFT Final Report, 1 Dec. 1964–23 Aug. 1965
Edward F. Kramer, Jr., (Tactical Hosp., Mac Dill AFB, Fla.) Henry B. Hale, and Edgar W. Williams Jun. 1966 15 p refs
(SAM-TR-66-59; AD-636911) CFSTI: HC $1.00/MF $0.50

Physiologic assessment was performed by means of postflight urinalysis for 8 pilots who flew F-4C aircraft for 18 hours. Flight effects were neither numerous nor of large magnitude, nor were the pilots unduly fatigued. The flight-induced, physiologic changes included: (1) increased 17-hydroxycorticosteroid excretion, which implies adrenocortical stimulation, and (2) decreased excretion of uric acid, potassium, and urine, which suggests metabolic depression. Author (TAB)

N66-37259# RAND Corp., Santa Monica, Calif.
THE CLASSICAL STRUCTURE OF BLOOD BIOCHEMISTRY—A MATHEMATICAL MODEL
E. C. De Land Jul. 1966 134 p refs
(Contract AF 49(638)-1700; Proj. RAND)
(RM-4962-PR; AD-635886) CFSTI: HC $4.00/MF $1.00

The mathematical simulation of human blood biochemistry includes the results of detailed chemical analysis of human blood under a variety of chemical stresses. Mathematical simulations of increasing degrees of complexity are developed. A rudimentary-blood model assumes the conventional roles of the fixed proteins, the neutral electrostatic charge constraints, and the active cation pump as the major characteristics of hemostatic blood. The microscopic properties of the proteins, particularly their buffering behavior, are incorporated into the model by a mathematical procedure that assumes that the serum albumin and the various globulins represent all of the important buffering power of the plasma fraction. A model of the respiratory biochemistry of the blood, embodying the results of the previous biochemical structural detail, is tested under various conditions. Properties of the mathematical model, such as gas exchange, buffering, and response to chemical stress in the steady state, are practically indistinguishable from those properties of real blood within the limits of the present validation program. Author (TAB)

N66-37278*# Aerospace Medical Div. Aerospace Medical Research Labs. (6570th), Wright-Patterson AFB, Ohio.
TOXICITY STUDIES OF COOLANOL 15 Final Report, Jan.–Sep. 1965
Ralph F. Ziegler, Farrel R. Robinson, and David T. Harper, Jr. Dec. 1965 22 p ref
(NASA Order T-31248-G)
(NASA-CR-78150; AMRL-TR-65-213) CFSTI: HC $1.00/MF $0.50 CSCL 06T

Coolanol ® 15, a synthetic heat transfer fluid, is currently being used in the heat transfer systems of manned spacecraft. The current studies were undertaken to confirm or refute previously reported effects on the central nervous system and to acquire additional information on the toxicity of this compound. The effects of single intraperitoneal injections in mice and rats, repeated subcutaneous injections in rabbits, and the repeated cutaneous application on the unabraded skin of rabbits, monkeys, and dogs were investigated. Parenteral injection revealed that Coolanol 15 is relatively nontoxic. The LD_{50} for mice was found to be greater than 20.0 gm (22.2 ml) per kg at 24 hours and 5.9 gm (6.6 ml) per kg at 7 and 14 days. Repeated subcutaneous injections in rabbits resulted primarily in localized reactions at injection sites. The only effects which could be directly attributed to the cutaneous application of 3.6 gm (4.0 ml) per kg per day for 20 days involved the skin.

Drying and encrustation and/or desquamation of the superficial layers of the skin were the principal lesions observed clinically, while microscopic examination revealed varying degrees of hyperkeratosis and cellular infiltration. These studies failed to confirm the previously reported lesions in the central nervous system attributed to Coolanol 15. Author

N66-37282*# Naval School of Aviation Medicine, Pensacola, Fla. Naval Aerospace Medical Inst.

INFLUENCE OF CONTACT CUES ON THE PERCEPTION OF THE OCULOGRAVIC ILLUSION

Brant Clark and Ashton Graybiel 5 Aug. 1966 15 p refs Joint Rept. with NASA

(NASA Order R-93)

(NASA-CR-78269; NAMI-976) CFSTI: HC $1.00/MF $0.50 CSCL 06N

Measurements were made on five normal and five labyrinthine-defective men when they stood erect in a room while it was stationary and again when it was rotating. The procedure was designed to produce two situations for the normal men in which otolith and non-otolith information were synergistic and three others in which they were antagonistic. Perception of the visual horizontal during rotation was not systematically related to differences in head and body position, nor were there significant differences between the normal and L-D men. The results show that nonotolith information predominates in this experimental situation. Author

N66-37283*# Naval School of Aviation Medicine, Pensacola, Fla. Naval Aerospace Medical Inst.

HISTOLOGICAL STUDY OF SPONTANEOUS EAR INFECTIONS IN ALBINO RATS

Makoto Igarashi and Albert E. New 20 May 1966 19 p refs Joint Rept. with NASA

(NASA Order R-93)

(NASA-CR-78270; NAMI-967) CFSTI: HC $1.00/MF $0.50 CSCL 06C

When albino rats are used for otological experiments, it is unnecessary to have a large number of experimental animals as there is no precise method for detection of spontaneous ear infection of the rat in the vital status. Post-mortem histological investigation is the only reliable procedure available by which otological infections can be detected. The ears of 16 albino rats originating from three different suppliers were histologically examined. Spontaneous middle ear infection was found in an average of 25% of the ears. Author

N66-37321*# Naval School of Aviation Medicine, Pensacola, Fla. Aerospace Medical Inst.

THE INVERSION ILLUSION IN PARABOLIC FLIGHT: ITS PROBABLE DEPENDENCE ON OTOLITH FUNCTION

Ashton Graybiel and Robert S. Kellogg 20 Jul. 1966 15 p refs Joint rept. with NASA *Its* rept.-134

(NASA Order R-93)

(NASA-CR-78067; NAMI-974) CFSTI: HC $1.00/MF $0.50 CSCL 06S

Observations were made on normal subjects and deaf persons with bilateral labyrinthine defects (L-D subjects) under three different conditions in parabolic flight: (1) free-floating, (2) restrained in a Fiberglass mold, and (3) standing on the overhead during a modified parabola generating about −0.05 G unit. There were interindividual differences in the reactions among the normal but not among the L-D subjects. Some normal but none of the L-D subjects experienced a reversal of their personal orientation with regard to up-down under all three conditions. This reversal was considered to have its genesis in the vestibular organs, probably the otolith apparatus. Findings are in accord with Russian reports describing feelings of inversion among cosmonauts in orbital flight. Attention is called to the necessity of distinguishing between information furnished by touch-pressure, kinesthesis, and stereognosis under ordinary conditions and agravic touch-pressure, agravic kinesthesis, and agravic steragnosis. Author

N66-37341# Pacific Northwest Research Foundation, Seattle, Wash.

EFFECTS OF IONIZING RADIATION RADIATION ON TESTICULAR FUNCTION OF MAN Second Yearly Progress Report, 1 Jun. 1964–31 May 1965

Carl G. Heller 15 Mar. 1965 35 p refs

(Contract AT(45-1)-1780)

(RLO-1780-8) CFSTI: HC $2.00/MF $0.50

Progress is reported on: design and use of X-ray apparatus for uniform irradiation of human testes; hormonal evaluations; seminal fluid counts; quantitation of the germinal epithelium; assessing Leydig cell function; chromosomal studies; and tritium labeling in X-ray studies. Hormonal evaluations were made on subjects that received 5, 15, 20, 25, 50, 100, 300, 400, or 600 R. Estrogen, ICSH, and 17 ketosteroid data revealed no apparent changes after radiation compared to that of the control period. There was, however, a highly significant rise in gonadotropins following irradiation for every dose level and every subject. Of the subjects undergoing testicular biopsy, only 39% experienced a drop in sperm count, and this decrease always occurred within the first ten weeks. A technique was devised for evaluating the structural changes in Leydig cells and relating these to observed hormonal changes, or lack of changes. Problems inherent in the study of pachytene bivalents are discussed. Preliminary studies were conducted on two individuals to determine if labeled sperm could be detected through the depletion period following irradiation, and therefore, to prove that the preleptotene spermatocyte is not as radiosensitive as the spermatogonia. The two individuals were injected with ^{3}H-thymidine just prior to irradiation, and smears of their seminal fluid were followed by radioautography. Labeled sperm appeared after 46 days and continued until the tubules were empty and the subjects zoospermic as determined by routine seminal fluid counts. NSA

N66-37342# Brookhaven National Lab., Upton, N. Y.

HEMATOLOGICAL EFFECTS OF SPACE RADIATION

Robert A. Conard [1965] 31 p refs

(Contract AT(30-2)-GEN-16)

(BNL-10221) CFSTI: HC $2.00/MF $0.50

Available data on the hematological effects of space radiation on man are reviewed. The data indicate that the bone marrow is, under most circumstances, the most critical organ for damage from radiation. The blood forming tissues possibly do not have the regenerative or renewal capacity that the gastrointestinal epithelium has, and will, in most cases, be the limiting factor for survival. Neutrophil and platelet levels will be of primary importance in regard to the fitness and survival of the astronaut from the hematological point of view. Peripheral blood counts, both preflight and in-flight, for total white cell count (with neutrophil and lymphocyte levels) offer the best index of prognosis from the point of view of hematopoietic damage. Lymphopenia must be interpreted with caution, since dose distribution patterns and abscopal effects from partial body irradiation may give lower values than indicative of general bone marrow damage. The development of fever, infection, bleeding are signs of severe bone marrow damage. Abortion of a mission is indicated if any accumulated whole body dose of radiation of greater than 150 rads in a 48

hour period occurs; white blood counts drop below 2000 cells per cubic mm and neutrophils below 1000 cells per cubic mm; or if associated fever, infections, or bleeding occur. Very large doses of partial body radiation may be tolerated without lethal depression of circulating blood cells. Shielding part of the bone marrow may be an important factor in preventing serious hematological depression. It is recommended that serious consideration be given to providing shielding of part of the bone marrow of the astronaut. A lead apron over the pelvic region would shield about 40% of his bone marrow, and he could then withstand considerably larger doses of radiation to the remainder of his body. The dose rate and depth-dose distribution patterns of space radiation are the most important physical considerations in determining total bone marrow damage. High proton flux irradiation associated with solar flares presents the most serious radiation hazard. Based on limited data, the quality of radiation delivered to the bone marrow does not appear to present any special hazards, since the RBE appears to be about 1 or only slightly above for most space radiations that penetrate to the depth of the bone marrow. Author (NSA)

N66-37360*# Naval School of Aviation Medicine, Pensacola, Fla. Naval Aerospace Medical Inst.

LACK OF RESPONSE TO THERMAL STIMULATION OF THE SEMICIRCULAR CANALS IN THE WEIGHTLESSNESS PHASE OF PARABOLIC FLIGHT

Robert S. Kellogg and Ashton Graybiel 9 Aug. 1966 16 p refs

(NASA Order R-93)

(NASA-CR-78224; NAMI-977) CFSTI: HC $1.00/MF $0.50 CSCL 06S

The objective of this study was to clarify the mechanism of caloric nystagmus in man by conducting the test in weightlessness. Eight subjects were selected on the basis of a strong nystagmus response to irrigation with ice water. Nystagmus was determined by oscillograph tracings and direct observation, and, in addition, subjective responses of the subject were obtained. The experimental evidence indicated that, under the conditions of this experiment, zero gravity completely suppressed caloric nystagmus. This supported Barany's original hypothesis that caloric nystagmus was dependent on difference in specific weight of the endolymph in the horizontal canal. Author

N66-37425# Joint Publications Research Service, Washington, D. C.

SOVIET GOALS AND SOME ACHIEVEMENTS IN PSYCHOLOGY

P. K. Anokhin et al 2 Sep. 1966 59 p Transl. into ENGLISH from Vopr. Psikhologii (Moscow), v. 12, no. 3, May–Jun. 1966 p 3–9, 10–32, 39–43, 44–48, 184–188

(JPRS-37416; TT-66-33844) CFSTI: $3.00

Translations of five articles covering the problems of psychology in the following areas are presented: the objects of psychology; cybernetics and integrative brain activity; heredity, environment, brain, and problem solving; electrical activity of the deep structures of the brain when studying the immediate memory; and a discussion of the book "Problems of Social Psychology". C.T.C.

N66-37426# Rochester Univ., N. Y. Dept. of Electrical Engineering.

ELECTRICAL RESISTIVITY OF LUNG AT 100 kc/sec

Edwin Kinnen and D. Witsoe Brooks AFB, Tex., School of Aerospace Med., Jun. 1966 16 p refs

(Contract AF 41(609)-2278)

(SAM-TR-66-51; AD-636912) CFSTI: HC $1.00/MF $0.50

Average resistivity values of the lung were determined from measuremnts made on the surface of canine lung in vivo at 100 kc./sec. Data were taken at various levels of expiration with several different electrode configurations on each of 7 dogs. Theoretical considerations assumed the lung to be a homogeneous, isotropic, and primarily resistive medium at this frequency. The linear regression equation for resistivity as a function of lung air volume representing all data was calculated. The variation of resistivity values is characterized by a standard deviation of 180 ohm cm. for the distribution of individual experiment averages about the average of all data, at one-half expiration level. On the basis of assumptions relating normal and collapsed lung air volume, the resistivity of canine lung in situ can be expected to be around 1,800 ohm cm. at normal expiration. With inspiration, this value increases linearly by approximately 230 ohm cm. per 100 cc. Both of these values are expected to vary within 30% for an individual experiment, however. Comparison of the data taken with the various measurement technics on an individual animal indicated no discrepancy. Author (TAB)

N66-37436# Armed Forces Radiobiology Research Inst., Bethesda, Md.

A PROCEDURE FOR MINIMIZING PERSONNEL HAZARDS WHILE CHANGING TRITIUM TARGETS IN ACCELERATORS

J. A. Aberle, A. R. Macdonald, and S. W. Porter, Jr. May 1966 23 p refs

(AFRRI-TN66-5; AD-636185) CFSTI: HC $1.00/MF $0.50

A detailed procedure for minimizing personnel hazards while changing tritium targets in accelerators is given. The step-by-step process utilizes an airtight stainless steel glove box. The use of a plastic containment area is also described. Author (TAB)

N66-37437# School of Aerospace Medicine, Brooks AFB, Tex.

ECLIPSE BURNS IN HUMANS AND LABORATORY THRESHOLD MEASUREMENTS IN RABBITS

Ralph G. Allen, Jr. and Everett O. Richey May 1966 11 p refs

(SAM-TR-66-45; AD-635736) CFSTI: HC $1.00/MF $0.50

The radiant energy incident on the retina of a human viewing the noon-day sun is calculated as 4.25 cal./cm. sq.-sec. with an image diameter of 0.16 mm., assuming an atmospheric transmission of 85% and a pupil diameter of 2.5 mm. The retinal irradiance under the limiting conditions of 100% atmospheric transmission and 6 mm. pupil diameter is shown to be only 29 cal./cm. sq.-sec. This retinal irradiance is compared to experimentally determined retinal burn thresholds in rabbits. It is concluded that eclipse burns, which are known to occur, would not be predicted on the basis of extrapolated animal data, and that care must be exercised in using existing animal threshold data in predicting chorioretinal damage in humans. Author (TAB)

N66-37439# Army Medical Research Lab., Fort Knox, Ky.

ANNUAL PROGRESS REPORT, FY-1966

30 Jun. 1966 82 p refs

(RCS-MEDDH-288(R1); AD-636281) CFSTI: HC $3.00/MF $0.75

The investigations reported are related to: human vision, hearing, equilibrium, strength and endurance; effects of laser on ocular structures, immune mechanisms and other biologic models; effects of irradiation on behavior of rats and mice; extending human red blood cell survival, clarifying safety limits for use of group O blood donors and supplying blood to military units; infectious diseases of laboratory animals; dissolution of blood clots; corticosteroids; analysis and detoxification of snake venom. In addition, there is a report of a

Costan Rican effort related to antivenin production in that country and uncontrolled observations of treatment of human envenomation. Author (TAB)

N66-37442# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.

THE EFFECT OF LIGHT ON THE KETOSTEROID EXCRETION

Emil Wallner, Maria Kerepesi, and Magna Radnot 26 May 1966 14 p refs Transl. into ENGLISH from Acta Chir. (Hungary), v. 4, no. 3, 1963 p 181–188

(FTD-TT-65-1867; TT-66-61801; AD-635854) CFSTI: HC $1.00/MF $0.50

The day–night rhythmicity of ketosteroid excretion was studied in hospitalized patients, as well as the effect of light or the influence of the temporary elimination of light on the extent and the rhythm of the ketosteroid excretion. The 12 hour night fraction proved to be 30.5% less than the same fraction taken during the day. Complete darkness lasting from 7 to 10 days reduced the mean value of the excreted ketosteroids, although the day–night rhythm persisted.

Author (TAB)

N66-37446# Cambridge Univ. (England). Zoological Lab.

BIOLOGICAL CLOCKS AND THEIR INTERACTIONS IN INSECTS Final Scientific Report

Janet Harker 1 Nov. 1965 42 p refs

(Grant AF-EOAR-64-14)

(AFOSR-66-1478; AD-635770) CFSTI: HC $6.00/MF $0.50

The research described falls into four sections: (a) Histological investigations into the activity of the neurosecretory cells in the cockroach suboesophageal ganglion show that no clear changes occur in the stainable secretory material in these cells to parallel the animal's circadian locomotor activity cycle. The nuclei of some of these cells showed a possible circadian cycle of change in volume. (b) A method of bioassaying pharmacologically active extracts of cockroach tissues was set up. After initial trials it was considered that the necessary further development of the apparatus was not warranted. (c) Operations on the nervous system of cockroaches confirmed that the clock mechanism controlling the activity cycle could function without direct nervous connection between the suboesophageal ganglion and the corpora cardiaca. (d) The rate of development of Drosophila pupae is affected by factors following a circadian rhythm. The form of the rhythm is determined by both light-on and light-off signals, but the timing of the rhythm is determined by the two signals acting independently of each other. The circadian rhythm of eclosion of Drosophila cultures is shown to be the result of the summation of different individual rhythms of development at earlier stages. Author (TAB)

N66-37449# Naval School of Aviation Medicine, Pensacola, Fla.

TECHNIC FOR REMOVAL OF WHOLE RETINAS

Jesse Vasys Jul. 1966 13 p refs

(SAM-TR-66-67; AD-636725) CFSTI: HC $1.00/MF $0.50

A method of dissection that provides undamaged, intact retinas is described. Whole eyes are soaked successively in 10% buffered formaldehyde, distilled water, 60% alcohol, and distilled water. The eye globe is divided into two sections and the whole retina is removed by a gravity flow technic. The retina is then clover-leafed, stained, and mounted on a glass slide. Author (TAB)

N66-37450# Army Biological Labs., Fort Detrick, Md.

STERILIZATION WITH METHYL BROMIDE VAPOR

Daniel L. Jones and Charles R. Phillips Jul. 1966 22 p refs /*ts* Tech. Manuscript-304

(AD-636846) CFSTI: HC $1.00/MF $0.50

Methyl bromide vapor was shown to be bactericidal for the spores of Bacillus subtilis, and the vegetative cells of Staphylococcus aureus and Escherichia coli. The disinfection rate of B. subtilis spores has been determined for five different temperatures. Bacteria dried on cloth patches are sterilized more rapidly by methyl bromide vapor in atmospheres of low relative humidity than in atmospheres of higher relative humidity. Organisms in aqueous suspension can be sterilized by the admission of methyl bromide vapor to the atmosphere above the suspension in spite of the low solubility of methyl bromide in water. Such sterilization is not greatly influenced by changes in pH of the aqueous suspension, nor by the presence of organic matter of salt dissolved in the water. Methyl bromide has only about one-tenth the activity of ethylene oxide as a gaseous disinfectant, but since it is nonflammable it can be used in large-scale operations where safety precautions prohibit the use of ethylene oxide. It is believed that the mechanism is one of direct alkylation of protein material within the bacterial cell by methyl bromide. Author (TAB)

N66-37465# Naval Air Development Center, Johnsville, Pa.

DECREASE OF METABOLIC RATE BY PREOPTIC LESIONS AS CAUSE OF HYPOTHERMIA IN CATS

F. H. Jacobson and R. D. Squires 7 Jul. 1966 20 p refs

(NADC-MR-6605; AD-636724) CFSTI: HC $1.00/MF $0.50

The persistence of hypothermia in eight cats with lesions in the medial preoptic region of the forebrain was due in large part to their lower oxygen consumption per unit body weight after operation. Vasodilation inappropriate to the low body temperature occurred sometimes, as did vasoconstriction inappropriate to the rare high body temperature. Usually the cats were appropriately vasoconstricted. There was no decrease of the oxygen consumption per kilogram by five unoperated cats fasted until they lost 16.3% (mean) of their body weight. (The operated cats had lost 14.1% of their body weight). The lower metabolic rate of the lesioned cats, therefore, did not result from weight loss or reduced food intake, but from loss of preoptic tissue which normally, when its temperature falls, stimulated metabolism. Author (TAB)

N66-37547# Federal Aviation Agency, Oklahoma City, Okla. Office of Aviation Medicine.

THE AEROMEDICAL ASSESSMENT OF HUMAN SYSTOLIC AND DIASTOLIC BLOOD-PRESSURE TRANSIENTS WITHOUT DIRECT ARTERIAL PUNCTURE

Michael T. Lategola May 1966 21 p refs

(AM-66-16)

A system for vitually continuous measurement of both systolic and diatolic blood pressures without recourse to direct arterial puncture has been effected by the modification of already existing standard equipment. This sytem entails the measurement of systolic blood pressure with a digital pressure cuff on one arm simultaneously with the measurement of diastolic blood pressure from a bracial cuff mounted on the other arm. The systolic-pressure device was used virtually unmodified. The diastolic-pressure device was originally designed to measure both systolic and diastolic pressures automatically. The modification consisted mainly in the elimination of the systolic portion of the automatic cycle. The

combined system is capable of routinely obtaining measurement frequencies in the order of 20 per minute for protracted time periods. The system functions well under all resting-subject conditions and under some "body-movement" conditions. This system is currently in routine use in all of our aeromedically oriented research involving the assessment of cardiopulmonary function. Author

N66-37564*# Neuroscience Research Program, Brookline, Mass.
SLEEP, WAKEFULNESS, DREAMS AND MEMORY
Walle J. H. Nauta and Werner P. Koella 31 May 1966 107 p refs *Its* Bull. V. 4, No. 1
(Grants NsG-462; NIH GM-10211-04; Nonr(G)-00067-65)
(NASA-CR-78365) CFSTI: HC $4.00/MF $0.75 CSCL 05J

Mechanisms of the sleep–wakefulness cycle are studied, especially as manifestations in changes of central neural activity and attendant perceptual, ideational, and behavioral states. The physiological phenomenology of sleep is analyzed, and mechanisms of sleep induction, maintenance, and termination are discussed. The psychological phenomenology of normal sleep and of abnormal states of sleep and wakefulness are also considered. An extensive bibliography of relevant publications is included. A.G.O.

N66-37586*# Colorado State Univ., Fort Collins.
THE USE OF PATHOGEN-FREE PLANTS IN A MICROCOSM, PART II Final Report, Jan. 1–Jun. 30, 1966
Ralph Baker [1966] 11 p Submitted for Publication
(Grant NsG-78-60)
(NASA-CR-78354) CFSTI: HC $1.00/MF $0.50 CSCL 06F

A prototype germfree controlled environment plant growth chamber was developed. The main physical characteristics of the unit are diagrammed, its various subsystems are described, and its theory of operation is discussed. Initial tests of the chamber established the feasibility of the design, however modifications were necessary. Completed modifications of the unit are outlined along with improvements still in progress. Drawings of the modified prototype are also shown. The initial evaluation was interrupted because of icing problems. Modifications to eliminate this and other design deficiencies are being completed. The evaluation did show that the unit would meet the original temperature specification of 10° to 35° C. However, it consistently delivered a low relative humidity of 52% as compared to the desired low of 10%. This figure could be improved with a more complicated and expensive dehumidifying system. The chamber does represent a considerable advancement over modified animal tents which have been used as plant growth chambers and is better in all respects than any other previously developed germfree plant growth chamber. R.N.A.

05 BIOTECHNOLOGY

Includes life support systems, human engineering; protective clothing and equipment; crew training and evaluation, and piloting. For related information see also: 04 Biosciences.

N66-36429*# New York Academy of Sciences, N. Y.
REGENERATIVE SYSTEMS
Allan H. Brown (Pennsylvania Univ.) *In its* Human Ecol. in Space Flight, Vol. I 1966 p 82–119 refs (See N66-36427 22-04) CFSTI: HC $7.00/MF $1.75

The use of microorganisms for regenerating the gases needed to maintain a proper space cabin ecology over prolonged periods of flight, are discussed. A block diagram of one such chemosynthetically balanced closed ecological system in which hydrogen bacteria are used for biosynthesis, is depicted. Factors considered are: (1) the possibilities of spontaneous mutations that may occur in the bacterial systems, (2) the matching of assimilatory and respiratory quotients, (3) the fixation of hydrogen, (4) the effect of oxygen concentration in the system on the rate of bacterial growth, (5) carbon dioxide consumption rates, and (6) intermediate bacterial wastes. A chart indicating the power and weight requirement estimates for algal and bacterial regenerative systems for a theoretical 270 man-day mission is presented. Also discussed are the edibility of algae, and the question of a chemically defined diet. L.S.

N66-36496*# National Academy of Sciences—National Research Council, Washington, D. C. Space Science Board.
INSTRUMENTATION FOR THE DETECTION OF EXTRATERRESTRIAL LIFE
Carl W. Bruch (NASA, Washington) *In its* Biol. and the Exploration of Mars 1966 p 487–502 (See N66-36466 22-04)
CFSTI: HC $8.27–MF $2.75

The characteristics and state of development of instrumentation and experimental methods for the detection of extraterrestrial life are reviewed in terms of the kinds of evidence (morphological, chemical, and physiological) they are intended to provide. S.C.W.

N66-36517# Boeing Co., Seattle, Wash.
OPTIMIZATION OF CREW COMFORT SYSTEM
John R. Malcolm and Roland K. Moir *In* Canaveral Council of Tech. Soc. 3d Space Congr. 1966 p 156–172 refs (See N66-36506 22-30)

An engineering evaluation of the environmental parameters that affect man's comfort during shirtsleeve operation under conditions of weightlessness is presented. To obtain a minimum weight system, the penalty for providing convective, radiative, and evaporative cooling was established. Mathematical expressions were developed to relate how the total metabolic heat generated by a crew member is divided among radiation, convection, and evaporation. These expressions included the vehicle design parameters—air temperature, relative humidity, air velocity, and mean radiant temperature (MRT)—and the crew-oriented parameters of clothing thermal resistance and effective wetted surface area. A basic premise was that the system be designed so that the crew member's effective wetted skin is 10 percent of the total area, and the crew member is comfortable under these conditions. Author

N66-36518# Goodrich (B. F.) Co., Akron, Ohio. Aerospace and Defense Products Div.
TRANSIENT THERMAL STUDY OF A SPACE SUIT CLAD ASTRONAUT ON THE MOON
Robert J. Martin *In* Canaveral Council of Tech. Soc. 3d Space Congr. 1966 p 173–184 (See N66-36506 22-30)
(Contract NOw-61-0554-c)

A transient thermal analysis of a space suit clad man on the moon is presented. No refrigeration system is considered for his suit, and it is assumed that the only evaporative cooling is that achieved through the saturation of the occupant's exhalation. These restrictions are imposed because the primary concern is to determine whether useful mission times are possible without recourse to special cooling devices. Practicable exposure times are demonstrated for the lunar day. The analysis also shows that extended mission times are easily feasible for the lunar night side. Author

N66-36526# Brown Engineering Co., Inc., Huntsville, Ala.
A METHODOLOGY TO ANALYZE AND EVALUATE CRITICAL HUMAN PERFORMANCE
M. A. Barone *In* Canaveral Council of Tech. Soc. 3d Space Congr. 1966 p 270–283 refs (See N66-36506 22-30)

A methodology to evaluate, analyze, and predict critical human performance is presented. The aim of the program is to develop a methodology to control and minimize the natural subjectivity associated with evaluation programs. The typical approach is: (1) analyze the system or task, (2) select evaluation factors, (3) establish and prevalidate a rating manual or check list, (4) perform an analysis and evaluation, (5) estimate potential error probabilities, and (6) perform critical comparison studies. Author

N66-36601# Michigan State Univ., East Lansing. Div. of Engineering Research.
A SYSTEMS APPROACH TO HIGHER EDUCATION—A COMPREHENSIVE REPORT OF PROGRESS
H. E. Koenig, M. G. Keeney, M. J. King, P. Gindre, J. E. Griggs et al 15 May 1966 101 p refs
(Contract NSF C-396)
(IR-3)

The report presents a first generation model characterizing the dynamic relationship between the flow of students and resources and their associated imputed values at the "input and output terminals" of an institution of higher education. The model is a system of simultaneous difference equations whose coefficients are stated as an explicit function of the academic programs of the students and the administrative policies of the institution; it identifies 96 internal student population levels and the demands placed on the institution by their academic programs and the resources and the associated unit costs required to meet these demands. Data acquisition and processing procedures are given for evaluating those parameter matrices in the model for which a data base accessible to a computing machine is currently available. A data processing system that will provide the additional required data base is also described. The model enables the administrator to experiment with various combinations of policy and resource allocations. The interaction of higher education with the national economy is demonstrated in terms of a simplified version of the basic model. In addition to the number of students, manpower and resources, and their associated imputed values, other dimensions of education are given as they relate to academic and administrative policy, cost, and student interest. Author

N66-36688# Joint Publications Research Service, Washington, D. C.
BIONICS—ITS STATUS AND TRENDS IN ITS DEVELOPMENT
A. Berge and B. Sotskov 13 Sep. 1966 31 p refs Transl. into ENGLISH from Nauka i Zhizn (Moscow), no. 6, Jun. 1966 p 2–12
(JPRS-37552; TT-66-33980) CFSTI: $2.00

Attention is drawn to four main groups of problems encountered in informational aspects of bionics. These areas include the obtaining of information; information processing (transformation, storage and comparison with input information); the formulation of new information; and the use of information for the control of substantial or energetic processes. General aspects related to these problems are examined. Advances in biological investigations are discussed from an engineering point of view to emphasize the need for the perfection of technical means of communications to effectively disseminate this information. The importance of creating a common language for biologists, medics, and specialists in cybernetics and electronics is also assessed. H.S.W.

N66-36761# Joint Publications Research Service, Washington, D. C.
PROBLEMS OF TRANSFER OF TRAINING IN MOTOR ACTS
V. M. Zatsiorskiy *In its* Coord. of Motor and Vegetative Functions in Man during Muscular Activity 18 Aug. 1966 p 16–34 (See N66-36759 22-04) CFSTI: $2.00

Transfer of motor task training results to the successful performance of other movements is considered. The forms of training transfer such as direct, mediated, and unilateral, are discussed, and the investigation method which uses variation statistics and factorial analysis is described. The problems of homogeneous transfer of speed and endurance are analyzed, and a correlation between the magnitude of transfer and training level is related. A.G.O.

N66-36848*# Lockheed Missiles and Space Co., Palo Alto, Calif.
DESIGN AND DEVELOPMENT OF A WATER VAPOR ELECTROLYSIS UNIT
W. J. Conner, B. M. Greenough, and G. M. Cook Washington, NASA, Sep. 1966 126 p refs
(Contract NAS2-2630)
(NASA-CR-607) CFSTI: HC $3.00/MF $1.00 CSCL 06K

Development of a water vapor electrolysis cell using sulfuric acid as the electrolyte proved that this system is competitive with other zero-gravity methods of generating breathing oxygen. The properties of sulfuric acid were studied and the results indicate that it is a suitable electrolyte with a high water absorption characteristic. The immobilizing gel matrix materials tested were generally unsuitable for the water vapor electrolysis cell. Experimental gelled matrix cells were operated under adverse operational conditions to determine failure modes. Unique liquid electrolyte-absorbent matrix cells were efficiently operated at high current densities and water absorption rates. A 1-man unit of this design would require 14 cells, 284 W, 2.24 V at100 mA/cm^2, weigh 19.7 lb, and occupy 0.19 ft^3. Author

N66-36898# Tufts Univ., Medford, Mass. Dept. of Mechanical Engineering.
A STUDY IN MOLECULAR SENSATION Semiannual Report
Dwight W. Batteau and William M. Hemmes 24 Mar. 1966 39 p refs
(Contracts Nonr-4863(00); N123(60530)52597A)
(SAR-1; AD-635955) CFSTI: HC $2.00/MF $0.50

The hypothesis is posed that organic sensation is provided by shifting the probability of transition of electrons from excited states to the ground state in organic molecules. Also hypothesized is that the action potentials observed are metabolic artifacts and not carriers of sensory signals. A description of applicable theory and two experiments are presented, as well as a few abstracted corollary remarks from the literature. Author (TAB)

N66-37050# School of Aerospace Medicine, Brooks AFB, Tex.
ASTROSTOMATOLOGY: DENTAL STANDARDS FOR THE SELECTION AND EXAMINATION OF SPACE CREWMEN
Jack L. Hartley and Gaylord L. Hall Jun. 1966 10 p refs
(SAM-TR-66-56; AD-635614) CFSTI: HC $1.00/MF $0.50

The report establishes guidelines for the necessary dental standards, examination procedures, and treatment criteria in support of manned space missions and simulated flights. Included are initial and final screening requirements, the establishment of oral hygiene and preventive measures, and

treatment recommendations. The preflight examination, in-flight monitoring, and postflight examinations for both chamber and actual flights are presented. A format for reporting the dental protocol of these flights is included. Author (TAB)

N66-37087# Institute for Defense Analyses, Arlington, Va. Research and Engineering Support Div.
HUMAN FACTORS PROBLEMS IN COMPUTER-GENERATED GRAPHIC DISPLAYS
Joseph E. Barmack and H. Wallace Sinaiko Apr. 1966 118 p refs
(Contract ARPA SD-50)
(S234; IDA/HQ-66-4820; AD-636170) CFSTI: HC $4.00/MF $0.75

The study is a review of current practices in computer-generated graphic displays from the point of view of engineering psychology. Input devices, which are integral to man–computer systems, are also considered. Theories of cognition are examined with respect to their applicability to computer-graphics. Author (TAB)

N66-37125# Federal Aviation Agency, Washington, D. C. Office of Aviation Medicine.
PHYSICIAN FLIGHT ACCIDENTS
Stanley R. Mohler, Sheldon Freud, Jack Veregge, and Elizabeth Umberger Sep. 1966 10 p
(AM-66-25)

Analysis of physician flight accidents during the period 1964–1965. More than thirty physicians sustained fatal injuries while piloting light aircraft: a fatality record four times the ratio of physician pilots in the general aviation pilot population. Author

N66-37142*# Bolt, Beranek, and Newman, Inc., Cambridge, Mass.
STUDIES OF MULTI-VARIABLE MANUAL CONTROL SYSTEMS: TWO AXIS COMPENSATORY SYSTEMS WITH COMPATIBLE INTEGRATED DISPLAY AND CONTROL
William H. Levison and Jerome I. Elkind Washington, NASA, Aug. 1966 153 p refs
(Contract NASw-668)
(NASA-CR-554) CFSTI: HC $3.25/MF $1.00 CSCL 05H

Experiments were conducted to determine what modifications to the current models of the human controller of single-variable systems are necessary for them to be good representations of the controller in two-variable situations. These experiments were performed with a single compensatory display and a single two-axis control. Two descriptors of performance were obtained for each axis: (1) the normalized mean squared error, and (2) the describing function. Of prime interest was the extent to which performance on a given axis was modified by the requirement of simultaneously tracking a second axis. Three two-axis control situations were investigated: (1) homogeneous control situation, in which the input power spectra and controlled elements were identical on X and Y, (2) heterogeneous inputs, in which the input bandwidths were different but the controlled elements identical, and (3) heterogeneous dynamics, in which the controlled-element dynamics were different but the input bandwidths identical. Author

N66-37190# Naval School of Aviation Medicine, Pensacola, Fla.
THE RELATIONSHIP OF FIVE PERSONALITY SCALES TO SUCCESS IN NAVAL AVIATION TRAINING
Howard L. Fleischman, Rosalie K. Ambler, Floyd E. Peterson, and Norman E. Lane 24 May 1966 13 p refs
(NAMI-968; AD-636268) CFSTI: HC $1.00/MF $0.50

Cattell's Sixteen Personality Factor Questionnaire, the Taylor Manifest Anxiety Scale, the Pensacola Z Scale, and the Adjective Check-List were evaluated as predictors of success/failure in Naval Aviation training. Results showed that certain personality variables contributed significantly to multiple prediction. Author (TAB)

N66-37217*# North American Aviation, Inc., Los Angeles, Calif.
PRELIMINARY ANALYSIS OF THE METABOLIC RATE MONITOR SYSTEM
G. W. Campbell, R. K. Breeze, D. Byrnes, and R. Tom 1 Jul. 1965 78 p refs
(Contract NAS4-876)
(NASA-CR-78287; NA-65-513) CFSTI: HC $3.00/MF $0.75 CSCL 06B

A preliminary evaluation was performed on a new concept for measuring oxygen consumption known as a metabolic rate monitor (MRM) along with an error analysis to determine its magnitude of errors for extreme ranges of conditions of R.Q., O_2 consumption, CO_2 production, etc. The mechanical components of the system were evaluated for source of error in measuring ability and a cursory evaluation was made of error magnitudes for both sea level and altitude conditions. The MRM was also evaluated using flow splitting venturies for minimizing diluent gas flow requirements. An error analysis was made for the theoretical operation of a flow meter type respiratory analyzer for comparison with the MRM. Alternate concepts of the MRM are described. The analyses showed that on a basis of error susceptibility and complexity of configuration, the respiratory analyzer using MRM concepts represents a higher development risk than the respiratory analyzer concept using a single flow meter. R.N.A.

N66-37268*# National Aeronautics and Space Administration, Marshall Space Flight Center, Huntsville, Ala.
DECK MOTION SIMULATOR PROGRAM—HORIZONTAL SINUSOIDAL OSCILLATION EFFECTS UPON PERFORMANCE OF STANDING WORKERS
J. S. Seeman and R. B. Williams Washington, NASA, Oct. 1966 48 p refs
(NASA-TN-D-3594) CFSTI: HC $2.00/MF $0.50 CSCL 05H

Simulation experiments were conducted to determine the effects on maintenance personnel of exposure to wind-induced oscillations of the Saturn V vehicle servicing platforms. It was determined that horizontal, linear, sinusoidal oscillation frequencies of 0.33 cps and 0.80 were satisfactory samples of expected wind conditions; corresponding amplitudes were ±6.3 inches and ±7 inches. A floor-mounted, electrohydraulically controlled deck motion simulator was used to reproduce some of the known motions; however, it did not reproduce the ellipsoidal motion pattern. Six mechanics, designers, and engineers participated in three tasks at each frequency and amplitude: hand assembly accuracy test, hand probe steadiness test, and visual acuity test. The instructions read by the subjects, and to the subjects, are included. Tentative conclusions based on test results indicate no significant differences at 0.33 cps; however, significant performance decrements appeared at 0.80 cps. It was found that at 0.80 cps workers cannot perform tasks requiring tow-hand operations; and increase of time does not result in increased performance accuracy of precision tasks. M.G.J.

N66-37288*# Houdry Process and Chemical Co., Philadelphia, Pa. Research and Development Dept.

FEASIBILITY STUDY OF A LOW TEMPERATURE CARBON DIOXIDE REMOVAL SUBSYSTEM, PART II Final Report

E. G. Bauer Jan. 1964 52 p refs *Its* Tech. Rept.-70

(Contract NAS9-1782)

(NASA-CR-65505; WO-87-0486) CFSTI: HC $2.50/MF $0.50 CSCL 06K

This study was conducted to determine the feasibility of removing metabolic carbon dioxide (CO_2) and water from the atmosphere of a four-man space cabin by means of a low-temperature freezeout process. The system is to run continuously for one year. The recovered carbon dioxide is passed to a reduction system where it is reduced to breathable oxygen and waste hydrocarbons. A portion of the recovered water is passed to an electrolytic cell and the remainder is used as drinking water. The results of this study indicated that the CO_2 removal system is feasible for systems having a compressor discharge pressure equal to or greater than 70 psia. Power requirement was minimum for the 70 psia system and was 550 watts. The equipment will require a volume of 7 ft^3 and will weigh 200 lbs. Author

N66-37289*# Houdry Process and Chemical Co., Philadelphia, Pa.

INTEGRATED CARBON DIOXIDE REDUCTION SYSTEM FEASIBILITY STUDY, PART I Final Report

J. D. Potts and J. J. Donovan 16 Apr. 1964 74 p refs

(Contract NAS9-1782)

(NASA-CR-65504) CFSTI: HC $2.50/MF $0.75 CSCL 06K

Results are presented from a design study and experimental program conducted to define a method for the physical recovery of carbon dioxide from the atmosphere of a space cabin and the chemical recovery of metabolic oxygen from carbon dioxide and metabolic water. The design study confirmed the original estimates for the carbon dioxide recovery system. It was found that the critical mechanical components were not state-of-the-art. The chemical efficiency of the carbon dioxide reduction process is about one-fourth that necessary to make good the postulated sizes and power demands of the proposal flow sheet. The mechanical design studies indicated the need for developing small, high temperature control valves for the chemical process. It is recommended that a program of study be initiated to advance the state-of-the-art to a position where the proposed system can demonstrate its superiority to present systems. H.S.W.

N66-37309*# Honeywell, Inc., Minneapolis, Minn. Systems and Research Div.

MAN SYSTEM CRITERIA FOR EXTRATERRESTRIAL ROVING VEHICLES. PHASE IB: THE LUNEX II SIMULATION Interim Technical Report

J. E. Haaland 15 Jun. 1966 272 p refs *Its* Rept.-12504-ITR2

(Contract NAS8-20006)

(NASA-CR-78245) CFSTI: HC $6.00/MF $1.50 CSCL 06K

An 18-day lunar surface mission was simulated under laboratory conditions with two subjects to validate a minimum volume cabin design for a lunar roving vehicle. The cabin was evaluated with subjects performing representative scientific and mission orientated tasks using a 16-hour on and 8-hour off work-rest schedule. A 3000 calorie/day diet was provided. Driving, monitoring, navigation, sample measurement, and audio balancing tasks were evaluated. Subject's maximum oxygen capacity and heart and respiratory rates were obtained by measuring oxygen consumption during graded treadmill runs. Heart and respiratory rates were also taken continuously via a biotelemetry system. Water balance and urine analyses were performed. Subject's interaction in pressure suits with the vehicle interior volumes and workspace layout was evaluated during simulated emergencies. Daily extravehicular activities were performed while wearing inflated pressure suits, and the physiological stresses measured. No adverse trends or irregularities were noted and the subjects maintained satisfactory performance levels and physical condition throughout the simulation. R.N.A.

N66-37388# Royal Inst. of Tech., Stockholm (Sweden). Speech Transmission Lab.

ACOUSTIC SPECIFICATION OF SPEECH Final Scientific Report, 1 Jan.-31 Dec. 1965

C. G. M. Fant 31 Jan. 1966 15 p refs

(Grant AF-EOAR-65-51)

(AFCRL-66-294; AD-635633) CFSTI: HC $1.00/MF $0.50

This report summarizes results from speech research during the calendar year of 1965 at the speech transmission laboratory mainly in the field of speech production and speech analysis. Author (TAB)

N66-37399# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.

ON COGNITION OF SPEECH SOUNDS WITH THE AID OF SELF-ORGANIZING SYSTEMS WITH TWO POSITIVE FEEDBACKS

G. L. Otkhmezuri 25 May 1966 24 p refs Transl. into ENGLISH from Avtomatyka (Kiev), v. 9, no. 2, 1964 p 59-70

(FTD-TT-65-1851; TT-66-61798; AD-635849) CFSTI: HC $1.00/MF $0.50

The use of self-organizing systems in the role of cognitive devices of second-degree speech is discussed. Advantages of such systems in comparison with determinative systems are shown. Block diagrams are proposed for the cognizance of sounds with the use of self-organizing systems. Methods of improving the cognizance part by the introduction of additional bonds are given. Certain experimental results obtained with the use of self-organizing systems with one (basic) positive feedback are presented. TAB

N66-37454# Naval School of Aviation Medicine, Pensacola, Fla.

PERCEPTIONS AND ATTITUDES OF AVIATORS TOWARD VOLUNTARY WITHDRAWAL FROM FLIGHT TRAINING

Richard S. Pomarolli 8 Jun. 1966 17 p refs

(SR-66-4; AD-635602) CFSTI: HC $1.00/MF $0.50

The study used a questionnaire approach to investigate perceptions and attitudes of winged aviators toward voluntary withdrawl (DOR) from flight training. Results reveal widespread disagreement between DOR students and the aviators regarding what factors are of primary importance in the DOR process. In the assessment of pilot attitudes toward DOR'ing, the great majority of the group sampled expressed realistic and accepting attitudes toward this phenomenon. It is recommended that pilots assigned to instruction duty received thorough instruction regarding the factors in the DOR process. Author (TAB)

N66-37585*# Sandia Corp., Albuquerque, N. Mex.

EVALUATION OF THE EFFICIENCY OF A CLASS 100 LAMINAR-FLOW CLEAN ROOM FOR VIABLE CONTAMINATION CLEANUP. PART I: MICROBIOLOGICAL STUDIES RELATING TO CLEAN ENVIRONMENTS

John William Beakley, W. J. Whitfield, and J. C. Mashburn Sep. 1966 10 p refs
(NASA Order R-09-019-040)
(NASA-CR-78342; SC-RR-66-385) CFSTI: HC $1.00/MF $0.50 CSCL 06F

A laminar-flow wall-to-floor clean room was challenged with *Bacillus subtilis* spores and then tested for efficiency of cleanup using both electronic and viable particle detection systems. The results confirmed the extreme efficiency of laminar-flow systems in reducing airborne viable particles to an absolute minimum. Author

06 CHEMISTRY

Includes chemical analysis and identification (e.g., spectroscopy). For applications see: 17 Materials, Metallic; 18 Materials, Nonmetallic; and 27 Propellants.

N66-36455# Eidgenossische Technische Hochschule, Zurich (Switzerland).
CONTRIBUTION TO OUR UNDERSTANDING OF PEARL POLYMERIZATION [BEITRAG ZUR KENNTNIS DER PERLPOLYMERISATION]
Erich Hammer (Ph.D. Thesis) 1964 108 p refs In GERMAN (Rept.-3638) CFSTI: HC $4.00/MF $0.75

Pearl polymerization was investigated using a stable, geometrically exactly defined apparatus. Dependence of pearl size on the following variables was established: (1) container diameter; (2) stirrer diameter; (3) phase ratio; (4) viscosity of the monomer phase; (5) type and concentration of the protective colloids; and (6) type of the monomers. Eight various protective colloids were used. In all cases, particle size was irreversibly established during the first few minutes as long as pearl polymerization was possible at all. An empirical equation for pearl polymerization above the characteristic concentration of each protective colloid is presented, and applicability of the equation is discussed. It is concluded that in case of high concentration the yield of pearl polymer reaches a characteristic boundary value for each protective colloid; in case of sufficiently low concentration, the yield becomes quantitatively practical. Transl. by K.W.

N66-36458# Bureau of Mines, Albany, Oreg. Metallurgy Research Center.
THERMODYNAMIC PROPERTIES OF 65 ELEMENTS—THEIR OXIDES, HALIDES, CARBIDES, AND NITRIDES
Charles E. Wicks and F. E. Block 1963 146 p refs *Its* Bull. 605
GPO: $1.00

Thermodynamic functions and their applications are briefly reviewed, including heat content, heats of reaction and formation, heat balance, and free energy. Tabular data and graphs of thermodynamic values for 65 elements and their known oxides, halides, carbides, and nitrides are presented. All data and equations are in terms of calorie-gram mole-°K units, and the tabular values incorporate a base temperature of 298.15°K. L.E.W.

N66-36499# Eidgenossische Technische Hochschule, Zurich (Switzerland).
INVESTIGATION OF THE ACIDITY OF SOME AQUEOUS METAL IONS BY THEIR RAPID DEPROTONATION [UNTERSUCHUNG UEBER DIE ACIDITAET EINIGER METALLAQUO-IONEN DURCH DEREN RASCHE DEPROTONIERUNG]
Heinz Wenger (Ph.D. Thesis) 1964 102 p refs in GERMAN (Rept.-3446) CFSTI: HC $4.00/MF $0.75

Electrochemical reactions of aqueous mixtures of Cr^{3+}, Be^{2+}, Al^{3+}, Pb^{2+}, and Cu^{2+} with alkali hydroxide were measured 6 to 100 m/sec after mixing for their pH values in order to obtain the deprotonization functions for the various time factors. Solutions of beryllium perchlorate, beryllium chloride, and chromium perchlorate showed the following acid-base equilibrium constant reactions:

$$Be \cdot H_2O^{2+} \rightleftarrows BeOH^+ + H^+$$
$$Cr \cdot H_2O^{3+} \rightleftarrows CrOH^{2+} + H^+$$

Protonization functions for the aqueous copper and lead complexes depended upon the concentration of their ions. Aqueous copper equilibrium constants followed the reaction:

$$2\,Cu \cdot H_2O^{2+} \rightleftarrows Cu_2(OH)_2^{2+} + 2\,H^+$$

Experiments to obtain concentration independent protonization curves from deprotonization reactions of aqueous aluminum ions were not successful. Transl. by G.G.

N66-36596# Joint Publications Research Service, Washington, D. C.
ELECTROCRACKING OF LIQUID ORGANIC RAW MATERIAL, REPORT 2
N. S. Pechuro and A. N. Merkur'yev *In its* Electron. Treat. of Mater., No. 3, 1965 2 Sep. 1966 p 69–88 refs (See N66-36590 22-15) CFSTI: $4.00

Several electrical discharge techniques used in the decomposition of liquid organic products are surveyed. Among the methods considered are: (1) intermittent discharges consisting of rotating one or both electrodes; (2) intermittent discharges occurring between the surfaces of two rotating conical electrodes; (3) a reactor for decomposing various petroleum products, from gasolines to diesel fuels; (4) high voltage condensed discharge; (5) an electropyrolyzer for the combined decomposition of liquid and vaporized organic products; (6) a reactor design in which the current conducting electrodes are distributed in the form of a horizontal lattice; (7) intermittent discharges occurring between two electrodes, and numerous intermediate contacts situated between them on a lattice made of an insulating material; and (8) powerful electrical discharges (energy of an individual pulse up to 800 joules). Experimental results are compared, and it is assumed that this method of obtaining gases rich in unsaturated hydrocarbons and, in part, in acetylene has potential for the chemical industry. M.G.J.

N66-36758# Eidgenossiche Technische Hochschule, Zurich (Switzerland).
MICROWAVE SPECTRUM AND DIPOLE MOMENT OF NITRO ETHYLENE [MIKROWELLENSPEKTRUM UND DIPOLMOMENT VON NITROAETHYLENE]
Hansdieter Hess (Ph.D. Thesis) 1965 39 p refs In GERMAN
(Rept.-3520) CFSTI: HC $2.00/MF $0.50

The microwave spectrum of $H_2C{=}CHNO_2$ was measured and analyzed to identify the ground state and two excitation phases caused by vibrations of the NO_2-group. Rotational constants for the observed three phases were determined by computer analyses and the dipole moment of the nitroethylene ground state was established through splitting of the individual rotational transition lines. Comparison with calculated dipole values of the excitation phases showed that the vibrational oscillations did not effect the dipole moment. Resolution of the nuclear quadrupole hyperfine nitrogen structure was not achieved since the measured line width was too big. Experimentally obtained values for the inertia defect

showed a linear dependency on torsional vibrations of the NO_2-group and it was concluded that nitroethylene has a planar structure. Transl. by G.G.

N66-36762# Eidgenossische Technische Hochschule, Zurich (Switzerland).

SOLUTION CHARACTERISTICS OF POLYMERS WITH OXYGEN IN THE MAIN LINKAGE [LOESUNGSEIGENSCHAFTEN VON POLYMEREN MIT SAUERSTOFF IN DER HAUPTKETTE]

Georg Adank (Ph.D. Thesis) 1965 111 p refs In GERMAN (REPT.-3703) CFSTI: HC $4.00/MF $0.75

The solubility of polymers having oxygen groups in their basic molecular chain was studied by diffusion spectra, centrifugation, osmoses, vaporization, viscosity, and dielectricity of polydimethylsiloxane, polytetrahydrofurane, polypropylenoxide, and polyepichlorhydrine compounds. The differences between theta-dimensions and undisturbed dimensions were largest in the apolarized polymers and decreased in value from polyisobutylene, polystyrol, polymethylmethacrylate, polytetrahydrofurane down to polydimethylsiloxane. It was concluded that theta dimensions were strongly influenced by any association of a polymer. Transl. by G.G.

N66-36764# Portugal. Nuclear Energy Commission, Sacavem. Lab. of Physics and Nuclear Engineering.

ELECTRON PARAMAGNETIC RESONANCE STUDIES ON CHELATION OF ALKALI CATIONS BY THE *O*-DIMESITOYLBENZENE RADICAL ANION

B. J. Herold (Inst. Super. Tec., Lisbon), A. F. Neiva Correia, and J. dos Santos Veiga (Coimbra Univ.) 1965 12 p refs Repr. from J. Am. Chem. Soc., v. 87, 1965 p 2661-2665 Sponsored in Part by NATO

(LFEN.40(δ)) CFSTI: HC $1.00/MF $0.50

The stable radicals obtained by addition of alkali metals to o-dimesitoylbenzene in 1,2-dimethoxyethane (DME) and tetrahydrofuran (THF) were studied by electron paramagnetic resonance (EPR). A spectrum arising from the interaction of the unpaired electron with one alkali metal nucleus (quadruplet for Li, Na, and K and octuplet for Cs) and from two equivalent protons was observed. In the system o-dimesitoylbenzenepotassium in THF, finer structure from the mesityl groups consistent with considerable noncoplanarity was resolved. The unusually high splittings a_M due to the alkali metal are interpreted in terms of the formation of a chelate with partially covalent bonding. The fraction a_M/a (in which a is the hyperfine splitting constant for the free atom in the fundamental state) is shown to be a linear function of $r^{-1/2}$, r being the ionic radius of the metal. This correlation can be used to predict the alkali metal splitting and shows that the covalent character of the bond increases in the order Cs < K < Na < Li. For this type of complex, in which the ligand is a radical, EPR is shown to be a highly satisfactory method to reveal covalency of the bond to the metal. Author

N66-36801*# Colorado State Univ., Fort Collins.

COLLOIDS FROM CHEMICAL REACTIONS

G. W. Tompkin, Jr. *In its* Advanced Elec. Propulsion Res. 30 Jun. 1966 46 p refs (See N66-36794 22-28) CFSTI: HC $6.00/MF $1.25

Consideration is given to the preparation of colloid particles for electrostatic thrustors by the reaction of vapors. The particles considered have masses between 10^4 and 10^5 amu and have reasonably narrow size distributions. Condensation techniques were applied to chemical reacting and nonreacting systems, with other techniques studied in relation to mission parameters. A discussion is given of the reactive interaction of hydrogen halides and alkali metals; the reactions considered were those which had cross sections among the highest known in molecular beam studies. Work is reported with modified Sinclair-La Mer generators, from which strong indications are that suitable particles can be prepared. A study is included of aluminum as one of the reacting fuels for the production of colloid particles, with the choice of oxidizing reactant and reaction conditions being made from consideration of existing experience. C.T.C.

N66-36825# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.

STABILIZATION OF POLYSILOXANES BY ANTIOXIDANT ADDITIVES

R. I. Kobzova and G. S. Tubyanskaya 25 May 1966 12 p refs Transl. into ENGLISH from Khim. i Tekhnol. Topliv i Masel (Moscow), no. 9, 1964 p 53-56

(FTD-TT-65-1845; TT-66-61797; AD-635838) CFSTI: HC $1.00/MF $0.50

It was established that the most effective antioxidation additive to polyimethyl-siloxane oil (PMS-100) at the temperatures 250°, 300°, and 350°C, proves to be 1.4-dimezidinanthraquinone, the introduction of which in the amount of 0.5% improves the thermooxidation stability of PMS-100 at 300°C by a factor of 16 and at 250°C by a factor of 44. It was shown, that for some additives, the effectiveness of action with increasing concentration goes through a maximum, and the use of them above 3.0% is not feasible.

Author (TAB)

N66-36827# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.

INTERACTION OF ALUMINUM WITH CRYOLITE-ALUMINA MELTS

M. M. Vetyukov *In its* Electromet. of Nonferrous Metals 14 Jan. 1966 p 1-23 refs (See N66-36826 22-17) CFSTI: HC $2.00/MF $0.50

The interaction of aluminum with cryolite-aluminum melts is examined by investigating the composition and quantity of sublimates which are collected above the melts in the presence of metal. It is shown that the interaction flows with the formation of aluminum and sodium subfluorides. Oxidation of the melt leads to an increase of yield of the first product and a lowering of the second. An increase in the concentration of dissolved alumina decreases the intensity of the aluminum interaction with the melt. An investigation of the mixing effect on the interaction of aluminum with electrolyte, both in conditions of electrolysis and without current, showed that subion diffusion through the catholyte diffusion layer determines losses of metal or current and, subsequently, current efficiency. R.N.A.

N66-36839# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.

OUTLOOK FOR THE INTRODUCTION OF RADIOACTIVE DENSIMETERS OF LIQUID INTO THE INDUSTRY OF ORGANIC SYNTHESIS

M. A. Veksler, K. S. Furman, and G. A. Mukhin 25 May 1966 13 p Transl. into ENGLISH of the book "Trudy Vsesoyuznogo Soveshchaniya Radioaktivnyye Izotopy i Yadernyye Izlucheniya v Narodnom Khozyzystve SSSR" Moscow, Gostoptekhizdat, 1961 p 257-262

(FTD-TT-65-1668; TT-66-61795; AD-635836) CFSTI: HC $1.00/MF $0.50

Results are given of tests of a Gamma-emitting densimeter for monitoring liquids. TAB

N66-36862# Institute of Modern Languages, Inc., Washington, D. C.
ON THE FORMATION OF NOT COMPLETELY WEAR-RESISTANT COATINGS ON THE ANODIC OXIDE FILM WHEN ADDING CERTAIN DYES TO THE SEALING BATH [UBER DIE BILDUNG NICHT ABRIEBFESTER AUFLAGEN AUF DER ANODISCHEN OXYDSCHICHT BEIM ZUSATZ GEWISSER FARBSTOFFE ZUM SEALBAD]
F. Modic Jun. 1966 15 p refs Transl. into ENGLISH from Aluminium (Dusseldorf), v. 36, 1960 p 457–461
(Contract DA-44-009-AMC-1563(T))
(ERDL-T-1855-66; AD-635648) CFSTI: HC $1.00/MF $0.50

The report discusses the phenomenon of seal-action of certain dyestuffs added in small amounts to the sealing bath. It was confirmed that the seal-action can be related in all dyestuffs concerned to their molecular constitution. For their respective behavior are responsible certain specific chelate-forming groupings in the dyestuff molecule. Corresponding to these groupings, all seal-active dyestuff were subdivided into four classes. Dyestuffs with these groupings are capable of entering into a metallic complex during the sealing process with the not wear-resistant coating formed on the surface of the anodic film. It is most probable that the aluminum-complex dyestuff thus formed becomes water-soluble. This is the reason why this process produces after sealing always a shiny and wear-resistant anodic oxide film where the surface of the latter is completely free of not wear-resistant reaction products. Author (TAB)

N66-36932# Washington Univ., Seattle. Dept. of Chemistry.
COMPETITIVE UNIMOLECULAR DECOMPOSITION PROCESSES IN CHEMICALLY ACTIVATED SYSTEMS, 3-HEXYL RADICAL. INSERTION BY TRIPLET METHYLENE RADICALS IN ALKANE SYSTEMS
5 Jun. 1966 42 p refs
(Contract Nonr-477(36))
(TR-7; AD-633801) CFSTI: HC $2.00/MF $0.50

CONTENTS:

1. COMPETITIVE UNIMOLECULAR DECOMPOSITION PROCESSES IN CHEMICALLY ACTIVATED SYSTEMS D. C. Tardy, B. S. Rabinovitch, and C. W. Larson 30 p refs (See N66-36933 22-06)
2. INSERTION BY TRIPLET METHYLENE RADICALS IN ALKANE SYSTEMS D. F. Ring and B. S. Rabinovitch 6 p refs (See N66-36934 22-06)

N66-36933# Washington Univ., Seattle. Dept. of Chemistry.
COMPETITIVE UNIMOLECULAR DECOMPOSITION PROCESSES IN CHEMICALLY ACTIVATED SYSTEMS
D. C. Tardy, B. S. Rabinovitch, and C. W. Larson *In its* Competitive Unimol. Decomposition Processes in Chemically Activated Systems, 3-Hexyl Radical. Insertion by Triplet Methylene Radicals in Alkane Systems 5 Jun. 1966 30 p refs Submitted for Publication (See N66-36432 22-06) CFSTI: HC $2.00/MF $0.50

A general formulation of the rates of competitive unimolecular reactions is given and various relationships between the rates, and between the energetics, of competing processes are described. The relative and absolute rates of decomposition,

$$C-C-C-\dot{C}-C-C^{*}\xrightarrow{K_E^{p}}\cdot CH_3+C_5H_{10}^{-1}\xrightarrow{K_E^{b}}\cdot C_2H_5+C_4H_8^{-1}$$

were measured at pressures from 0.004 to 90 mm Hg for vibrationally excited 3-hexyl radicals, chemically activated by the addition of hydrogen atoms to trans-3-hexene at 300° C. Use of a quantum-statistical model for K_E in the general relations provides good theoretical agreement with the experimental data at all pressures. The results can also be used to lead to either of two alternative conclusions: that $D_o(CH_3-H)-D_o(C_2H_5-H)$ is 5.4 kcal/mole, or that the difference in critical energies for addition of methyl to pentene-1, E_o^m, and for addition of ethyl to butene-1, E_o^* is $E_o^m-E_o^*=-0.4$ kcal. TAB

N66-36934# Washington Univ., Seattle. Dept. of Chemistry.
INSERTION BY TRIPLET METHYLENE RADICALS IN ALKANE SYSTEMS
D. F. Ring and B. S. Rabinovitch *In its* Competitive Unimol. Decomposition Processes in Chemically Activated Systems, 3-hexyl Radical. Insertion by Triplet Methylene Radicals in Alkane Systems 5 Jun. 1966 6 p refs Submitted for Publication (See N66-36932 22-06) CFSTI: HC $2.00/MF $0.50

Earlier investigations indicated that triplet methylene radicals do not insert into C–H bonds. Later investigations revealed that photolysis of ketene and of diazomethane yield triplet methylene in addition to the singlet radical. In efforts to clarify these findings, the reactions of $^3CH_2$ with propane, n-butane, isobutane, and with alkane-ethylene mixtures were studied. Triplet methylene was produced by photolysis of 1:7 diazomethane-substrate gaseous mixtures, and analysis was made by gas chromatography. From these investigations, evidence is presented that triplet methylene radicals may, under certain conditions, insert into C–H bonds. H.S.W.

N66-36946# Los Alamos Scientific Lab., N. Mex.
POST-INDUCTION KINETICS IN SHOCK INITIATED H_2–O_2 REACTIONS
Charles W. Hamilton and Garry L. Schott [1966] 33 p refs for Presentation at 11th Intern. Symp. on Combustion, Berkeley, Calif.
(Contract W-7405-ENG-36)
(LA-DC-7661; CONF-660802-2) CFSTI: HC $2.00/ MF $0.50

The course of the shock initiated hydrogen–oxygen reaction after the induction period, during the transition to partial equilibrium, was investigated by computer integration of the rate equations, and approximate analytic descriptions of particular aspects are developed. H_2:O_2 ratios far from stoichiometric are considered. An earlier suggestion by one of the authors that partial equilibrium conditions with no recombination represent a practical upper limit to the transient atom and radical concentrations is contradicted, and attention is focused on the pronounced "spike" in oxygen atom concentration that modern rate coefficient data predict to occur in fuel-rich mixtures at the time of maximum reaction rates and most rapid O_2 depletion. Failure of measured OH concentrations to exhibit such "spikes" in rich mixtures is used to establish an upper limit to the ratio coefficients K_a/K_c. $H+O_2\xrightarrow{k_a}OH+O$ and $OH+H_2\xrightarrow{k_c}H_2O+H$, over the range $1156° \leq T \leq 1884°$ K Author (NSA)

N66-36970# Oak Ridge National Lab., Tenn.
THE NATURE OF SURFACE RADIATION-INDUCED DEFECTS IN IRRADIATED SILICON GEL. I: MECHANISM OF HYDROGEN ADSORPTION
G. B. Pariiskii, Yu. A. Mishchenko, and V. B. Kazanskii [1965] 21 p refs Transl. into ENGLISH from Kinet. Kataliz (USSR), v. 6, 1965 p 625–633
(ORNL-TR-1066)

According to the optical spectrum and the EPR spectrum of irradiated silica gel, the structure formed, under the action of irradiation, by the surface color centers, connected with additives in Al samples, was established. Irradiation caused positively charged holes, stabilized on the oxygen atoms and adjacent to atoms of Al. This defect appeared with centers of irreversibly adsorbed hydrogen. Author (NSA)

N66-36983# Oak Ridge National Lab., Tenn.
A STUDY OF THE CONTACT INTERACTION OF METALLIC BORIDES WITH GRAPHITE AT HIGH TEMPERATURES IN VACUUM [ISSLEDOVANIE KONTAKTNOGO VZAIMODEISTVIYA METALLOPODOBNYKH BORIDOV S GRAFITOM PRI VYSOKIKH TEMPERATURAKH V VAKUUME]
A. L. Burykina and T. M. Evtushok Sep. 1965 10 p refs Transl. into ENGLISH from Poroshkovaya Met., Akad. Nauk Ukr. SSSR (Kiev), no. 6, 1965 p 75–78
(ORNL-TR-801)

Contact reactions of compacted and powdered borides (TiB_2, ZrB_2, HfB_2, NbB_2, Mo_2B_5, and W_2B_5) with graphite and graphite powder were investigated at 2200°C in vacuum. The results of metallographic and chemical analyses and microhardness measurements showed that hafnium, niobium, tantalum, and tungsten borides remain stable at 2200°C for periods to 5 hr. Molybdenum boride is stable up to the melting point. After 5 hr at 2200°C, zirconium boride reactions with graphite powder resulted in some loss of weight and microhardness; reactions of ZrB_2 powder with compacted graphite resulted in an increase in graphite microhardness and a change in the chemical composition of the boride. NSA

N66-36984# Oak Ridge National Lab., Tenn.
APIGENIN AS A POSSIBLE REAGENT FOR THE DETERMINATION OF ALUMINUM IN PURE RARE EARTH MATERIALS
T. Nowicka-Jankowska and J. Minczewski [1965] 3 p refs Transl. into ENGLISH from Chem. Anal. (Warsaw), v. 10, 1965 p 129–130
(ORNL-TR-941)

The difficulty of determining the presence of aluminum in rare earth materials with the use of a large variety of reagents arises from the interaction of these reagents with rare earths as well as with aluminum. This difficulty can be circumvented to a large extent with the use of Apigenin as a reagent. Studies of aluminum determination have been made in materials containing lanthanum, praseodymium, gadolinium, holmium, yttrium, and scandium in the range of pH 3 to pH 6. Scandium was found to interact with apigenin. Except for this singular problem, the method of aluminum detection appears to have an ultimate sensitivity of better than 0.01 micrograms Al/ml. This was determined from studies at pH 4. NSA

N66-37004# Oak Ridge National Lab., Tenn.
STUDY BY THE EXTRACTION METHOD OF THE COMPLEXING OF CURIUM AND EUROPIUM [IZUCHENIE KOMPLEKSOOBRAZOVANIYA KYURIYA I EVROPIYA EKSTRAKTSIONNYM METODOM]
I. Stary 1965 8 p refs Transl. into ENGLISH of Joint Inst. for Nucl. Res. Rept. No. JINR-P-2001
(ORNL-TR-760)

On the basis of an investigation of extraction of curium and europium with thenoyltrifluoracetone in benzene, the extraction constants have been determined (log K = −7.30 for Cm and log K = −7.18 for Eu). Further, composition and stability constants were determined for complexes of curium and europium with tartaric acid (log β_2 = 6.84 for Cm and log β_2 = 6.79 for Eu), with oxalic acid (log β_2 = 8.8 and log β_3 = 12.1 for both Cm and Eu); with nitrilotriacetic acid (log β_2 = 20.13 for Cm and log β_2 = 20.42 for Eu), with ethylenediamintetraacetic acid (log β_1 = 17.10 for Cm and log β_1 = 17.34 for Eu) and with 1,2-diaminocyclohexaneterraacetic acid (log β_1 = 18.35 for Cm axd log β_1 = 18.51 for Eu). From the results obtained, it follows that the stability of complexes of curium is higher than those of americium, but it is lower than the stability of corresponding complexes of europium. Author (NSA)

N66-37007# United Kingdom Atomic Energy Authority, Harwell (England).
ON THE RADIOLYSIS OF LIQUID AMMONIA
L. Kolditz and U. Proesch Sep. 1965 52 p refs Transl. into ENGLISH from Z. Phys. Chem. (Leipzig), v. 218, 1961 p 108–140
(NP-TR-1351)

The radiolysis of liquid ammonia by γ-radiation has been thoroughly investigated by various methods. The first chemically determinable radiolysis products are radicals. The following yields have been obtained: G(H) = 0.94; G(NH_2) = 1.04. The primary molecule yields have the values G(H_2) = 0.37; G(N_2H_4) = 0.35. The progress of secondary hydrazine decomposition in an acid, neutral and alkaline medium is explained. Decomposition in an acid solution (in the presence of NH_4^+ ions) can be explained by the activity of solvated electrons. On the basis of the various results a radiolysis mechanism for liquid ammonia is advanced and compared with the known mechanism of the radiolysis of water. Author

N66-37008# United Kingdom Atomic Energy Authority, Harwell (England).
SOLVENT SENSITIZED RADIATION CHEMISTRY REACTIONS. I: REARRANGEMENTS OF CONJUGATED, UNSATURATED STEROIDAL KETONES
J. Hoigne, K. Schaffner, and R. Wenger Oct. 1965 23 p refs Transl. into ENGLISH from Helv. Chim. Acta (Basel), v. 48, no. 3, 1965 p 527–538
(NP-TR-1349)

Two unsaturated steroidal ketones undergo rearrangements on γ-irradiation in liquid solutions in the presence of aromatic sensitizers. The G-values in benzene solution were about 2, with only a small concentration dependence in the range from 0.015 to 0.39 mole/liter; τ (lifetime of benzene-excitation) multiplied by k_3 (reaction rate constant for energy transfer) was 290 1/mole. Decomposition was negligible. The rearrangements corresponded to those previously found on ultraviolet irradiation, and the γ-induced product distribution in benzene and toluene was similar to that obtained photochemically with wavelengths >280 nm. Another saturated ketone was stable when subjected to γ-irradiation under identical reaction conditions. The nature of the energy transfer reaction from aromatic molecules to the ketones is discussed. The radiolysis of the aromatic solvent is not quenched by this energy transfer process. Author (NSA)

N66-37013# United Kingdom Atomic Energy Authority, Harwell (England).
ON THE γ-RADIOLYSIS OF LIQUID AND SOLID AMMONIA
D. Schischkoff and D. Schulte-Frohlinde Sep. 1965 19 p refs Transl. into ENGLISH from Z. Phys. Chem. (Frankfurt), v. 44, Jan. 1965 p 112–121
(NP-TR-1342)

In the Co^{60} γ-radiolysis of ammonia, hydrogen, nitrogen, and hydrazine were formed. The G values of the products were determined for various doses and in the presence of various additives at 25° and −196°C. In the liquid state G values of the products changed with dose up to a stationary hydrazine concentration. In solid form, however, the G values were independent of dose, and no stationary hydrazine concentration appeared. An addition of isopropanol in liquid ammonia lowered the G value of nitrogen and increased that of hydrazine. However, in solid ammonia isopropanol had no influence on the G values of nitrogen and hydrazine formation. The significance of the results for the formation and decomposition of hydrazine is discussed. Author (NSA)

N66-37018# United Kingdom Atomic Energy Authority, Harwell (England).
THE DYNAMIC POLARISATION OF DEUTERONS IN A CRYSTAL OF LANTHANUM-MAGNESIUM NITRATE [DINAMICHESKAYA POLYARIZATSIYA DEITONOV V KRISTALLE LANTAN-MAGNIEVOGO NITRATA]
V. I. Lushchikov, Yu. V. Taran, and A. I. Frank 1965 9 p refs Transl. into ENGLISH of Joint Inst. of Nucl. Res. Rept. JINR-P-2007, 1965
(NP-TR-1283; JINR-P-2007) CFSTI: HC $1.00/MF $0.50

The solid-effect method was applied to the polarization of deuterium in a monocrystal of lanthanum–magnesium nitrate with a frequency 37 Gc. A large amplification of the deuteron polarization at thermal equilibrium, that corresponds to the deuteron polarization 4.5, was found. Author (NSA)

N66-37024# Brookhaven National Lab., Upton, N. Y.
THE ACTION OF LITHIUM VAPOR ON GRAPHITE
M. Bagouin, D. Guerard, and A. Herold Apr. 1966 5 p refs Transl. into ENGLISH from Compt. Rend. Acad. Sci. (Paris), Ser. C, v. 262, 14 Feb. 1966 p 557–559
(BNL-TR-78)

The action of lithium vapor on graphite produced the insertion compound of yellow LiC_6 from the first stage; purple LiC_{18} and blue LiC_{28} from the second stage; blue–black LiC_{36} from the fourth stage; and black LiC_{72} from the eighth stage. Author (NSA)

N66-37025# Northwestern Univ., Evanston, Ill. Dept. of Chemistry.
THE RADIATION CHEMISTRY OF HIGH POLYMERS Technical Report, 1 Apr. 1965–1 Apr. 1966
Malcolm Dole 1 May 1966 15 p refs
(Contract AT(11)1)-1088)
(TR-11; COO-1088-20) CFSTI: HC $1.00/MF $0.50

The use of ultraviolet absorption spectra in identifying transient and reactive species produced during and subsequent to the irradiation of polyethylene is discussed. Oxygen diffusion into and reaction with allyl free radicals in irradiated polyethylene was studied by ultraviolet spectroscopy. The temperature coefficients of crosslinking, double bond formation, and hydrogen gas evolution in irradiated polyethylene were determined over the temperature range from 25° to 120°C. Repurification of atactic and isotactic polypropylene oxide is described. NSA

N66-37075# Woods Hole Oceanographic Institution, Mass.
OCCURRENCE OF NORMAL PARAFFIN HYDROCARBONS IN NATURE
Robert C. Clark, Jr. Jul. 1966 59 p refs
(Contract Nonr-2196(00); Grant NSF GP-3250)
(WHOI-66-34; AD-635898) CFSTI: HC $3.00/MF $0.75

Tables are given which indicate the occurrence and, where available, the content of n-alkanes in land and marine plants, land and marine animals, the atmosphere, and (to a lesser extent) the earth's crust. A supporting bibliography of 444 items is included. TAB

N66-37084# London Univ. (England). Birkbeck Coll.
RESEARCH ON SILICON AND PHOSPHORUS DERIVATIVES OF VARIOUS NITROGEN COMPOUNDS Technical Report, Jan. 1961–Jan. 1962
Robert A. Shaw Wright-Patterson AFB, Ohio, AF Mater. Lab., May 1966 30 p refs
(Contract AF 61(052)-175)
(ASD-TR-61-305, Pt. II; AD-636269) CFSTI: HC $2.00/MF $0.50

Reactions of cyanuric chloride with trialkyl phosphites, diphenyl alkyl phosphites, triphenyl phosphite and diethylaniline are reported. Preparations and properties of 2, 4, 6-tris(iphenylphosphino)-s-triazine were investigated. New derivatives of hexamethyldisilazyl-lithium were prepared. Author (TAB)

N66-37088# Pennsylvania State Univ., University Park. Materials Research Lab.
CRYSTAL CHEMISTRY STUDIES Fourth Quarterly Report, 14 Feb.–13 May 1966
Rustum Roy, G. J. Mc Carthy, O. Muller, and W. B. White Ft. Monmouth, N. J., Army Electron. Command, Jul. 1966 48 p refs
(Contract DA-28-043-AMC-01304(E))
(ECOM-01304-4; AD-636054) CFSTI: HC $2.00/MF $0.50

Work was focused on the crystal chemistry of a family of rare earth–rhenium compounds. The work was completed and is presented in complete manuscript form as an appendix. The study of divalent rare earth compounds continued. The samarium silicate described in the last report was definitely identified and is described in detail. Attention has not been turned to the EO–CO–O system. Author (TAB)

N66-37096# Picatinny Arsenal, Dover, N. J. Plastics and Packaging Lab.
SYNTHESIS OF A POLYEPOXIDEPOLYHYDROXY ETHER
W. C. Tanner and E. A. Hoess Jul. 1966 19 p refs
(PA-TR-3323; AD-636100) CFSTI: HC $1.00/MF $0.50

The primary objective of the work was to chemically modify a polyhdroxy ether based on bisphenol A and epichlorohydrin by incorporating pendant gylcidyl groups for crosslinking. A polyhydroxy ether was converted to a thermosetting polyepoxidepolyhydroxy ether. Approximately six epoxy groups per molecule (DP 100) were incorporated; when crosslinked through the epoxy groups with m-phenylene diamine, the polymer became insoluble in dioxane whereas the original polymer was soluble. Author (TAB)

N66-37111# Royal Aircraft Establishment, Farnborough, (England).
FLUOROAROMATIC POLYMERS. PERFLUORO-META-POLYPHENYLENES
J. Thrower and Mary A. White Feb. 1966 25 p refs
(RAE-TR-66031; AD-482738) CFSTI: HC $1.00/MF $0.50

The Ullmann reaction in dimethylformamide has proved very successful for the synthesis of perfluoro-meta-polyphenylenes. Properties of model compounds and polymers described include general physical characteristics as well as thermal and thermal oxidative stability. Infrared, ultraviolet and mass spectra are briefly discussed. Author (TAB)

N66-37113# Hercules Powder Co., Wilmington, Del.
A STUDY OF THE ELECTRONIC CONFIGURATION AND BEHAVIOR OF THE $-NF_2$ GROUP Quarterly Report No. 13, Mar.–May 1966
Alan D. Craig and Alfred A. Albert 27 Jun. 1966 44 p refs
(Contract DA-31-124-ARO(D)-62; ARPA Order 402)
(AROD-4136-20; HRC-66-2; AD-484604)

The purpose of the research carried out under this contract is to learn more of the chemistry of compounds containing the NF_2 group and to look for new ions and compounds in the area of N–F chemistry. During this report period we have concentrated our efforts on making a comparison of the energy of the lowest available sigma orbital with the corresponding polarographic reduction potential, on

analysis of the fine structure of vibrational spectra, and on the kinetics of the reactions of anions with difluoramine. We have also continued our efforts in dipole moment measurements, mass spectrometry, and magnetic resonance. Particular emphasis is currently placed on reaction mechanisms. TAB

N66-37124# National Bureau of Standards, Washington, D. C. Physical Chemistry Div.

A BIBLIOGRAPHY ON ION-MOLECULE REACTIONS JANUARY 1900 TO MARCH 1966

F. N. Harllee, H. M. Rosenstock, and J. T. Herron 28 Jun. 1966 46 p refs

(NBS-TN-291) GPO: $0.30

The present document is a bibliography on reactions of chemical interest. The bibliography is listed in a chronological-alphabetic arrangement and includes 431 titles and references taken from the published literature since 1900. The coverage is limited to reactions between ions and molecules leading to changes in the atomic composition of either the projection ion or target molecule. No attempt has been made to completely cover resonant charge exchange or elastic scattering. Author

N66-37188# General Electric Co., Schenectady, N. Y. Research and Development Center.

PHOTOMETALLIC PROCESS INVESTIGATION Interim Development Report, Mar. 1–May 31, 1966

James F. Burgess and Donald L. Schaefer 14 Jun. 1966 26 p refs

(Contract NObsr-95045)

(IDR-2; AD-635143) CFSTI: HC $1.00/MF $0.50

The project has as its ultimate objective the fabrication of microminiature circuits in gold, nichrome, aluminum and silica by a process in which these materials are etched directly by a photosensitive material according to an incident light pattern. The evaluation of potential light sensitive halogens was extended. Spectrophotometric studies of chloro, bromo and iodo systems for etching gold were conducted. Etchant products are identified and etching mechanisms are proposed. Studies of the compatibility of polymers, solvents, and photo etchants were conducted. Reaction rate studies were initiated. The production of circuit patterns in gold and nichrome by several photometallic systems was demonstrated. Author (TAB)

N66-37191# California Univ., Los Angeles. Dept. of Chemistry.

MOLECULAR FLOW AND LANTHANUM CATALYZED BOND INTERCHANGE IN SODIUM PHOSPHATE POLYMERS

Adi Eisenberg and Shogo Saito Jun. 1966 31 p refs Submitted for Publication

(Contract Nonr-233(87))

(TR-12; AD-635586) CFSTI: HC $3.00/MF $0.50

It is observed that sodium phosphate polymers, in which some of the Na^+ ions have been replaced by La^{+++} ions, are subject to both simple molecular flow and to bond interchange in the glass transition region. These two relaxation mechanisms are separated, and their relative contributions to the shear viscosity are calculated. It is shown that the bond interchange mechanism is subject to an activation energy of ca. 50 Kcal, while that of the molecular flow is of the order of 200 Kcal at $T_g+30°C$; the latter is of the WLF form. It is further shown that the La^{+++} ions act as crosslinks, at least at low concentrations, and that the bond interchange occurs at the site of the La^{+++} ions, rather than at random along the polymer chain. Author (TAB)

N66-37207*# Georgia Inst. of Tech., Atlanta. Engineering Experiment Station.

CHEMICAL REACTIVITY OF HYDROGEN, NITROGEN, AND OXYGEN ATOMS AT TEMPERATURES BELOW 100°K Final Technical Report, 1 Dec. 1962–31 Dec. 1965

Henry A. Mc Gee, Jr. Jul. 1966 106 p refs

(Grant NsG-337)

(NASA-CR-78022) CFSTI: HC $4.00/MF $0.75 CSCL 07B

This project was concerned with developing the chemistry at cryogenic temperatures of systems that appear to be of significance in cometary phenomenon and in the atmospheric and surface chemistry of the Jovian planets. Several experimental arrangements for analyzing reactive gases and cryogenically stable liquids and gases are discussed. They include a cryogenic inlet system for a time-of-flight (TOF) mass spectrometer, an alternative experimental assembly using a small inexpensive magnetic mass spectrometer, fast inlet systems for use with several high energy dissociative processes, and two modifications for increased sensitivity of the TOF spectrometer. Several chemical reaction systems were investigated using these apparatus. These studies were sometimes exercises in chemical synthesis and sometimes from an interest in conducting reactions between the atoms and several simple molecules of carbon, hydrogen, oxygen, and nitrogen to relate the chemical behavior at cryogenic temperatures to that at more ordinary temperatures. Data on reactions of atomic hydrogen with ethane, ethylene, acetylene, nitric oxide, and liquid ozone; of atomic oxygen with ammonia, and of diazomethane with liquid ketene are presented. R.N.A.

N66-37218*# Wisconsin Univ., Madison. Theoretical Chemistry Inst.

AN ASSOCIATED SOLVENT THEORY OF POLYMER SOLUTIONS

W. Byers Brown and William D. Taylor (Pa. State Univ.) 16 Feb. 1966 32 p refs

(Grant NsG-275-62)

(NASA-CR-78262; WIS-TCI-160) CFSTI: HC $2.00/MF $0.50 CSCL 07C

An association theory of the thermodynamic properties of mixtures of a non-polar polymer with a polar solvent, based on the Flory-Huggins equation is described. The solvent molecules are assumed to associate to linear complexes which form an athermal Flory–Huggins mixture, while the polymer and the solvent complexes form a Flory–Huggins mixture with a single interchange energy parameter. The experimental dilution properties of mixtures of polypropylene with diethylketone and with di-isopropyl ketone, obtained from vapor pressure measurements, are shown to be satisfactorily described by the theory. The volumes of mixing exhibit the cubic type of dependence on composition possible theoretically, but the value of the Flory–Huggins parameter required is inconsistent with the other dilution properties. Author

N66-37229# Utah State Univ., Logan. Dept. of Chemistry.

INFRARED SPECTRA OF HIGH-BOILING SUBSTANCES IN INERT MATRICES Final Technical Report, 1 Jan. 1965–30 Jun. 1966

Richard L. Redington [1966] 20 p refs

(Contracts DA-31-124-ARO(D)-283; DA-31-124-ARO(D)-39) (AROD-5272-3; AD-635678) CFSTI: HC $1.00/MF $0.50

The primary purpose of the research was to study the nature of matrix-isolated monomeric and low polymeric alkali halide species. In these experiments, the vapor above molten alkali halide samples was isolated at liquid He temperature in an excess of a rare gas or other matrix material. The infrared spectrum was then recorded. The plan was to

study the structure or symmetry of the trapped species, determine their force constants, and in some cases establish their very existence. In addition, the interaction of the trapped species with the matrix host was of fundamental importance. A number of other studies which proceeded as out-growths from the above primary objectives are described. Author

N66-37246# Army Missile Command, Huntsville, Ala. Translation Branch.
INTRODUCTION OF AROMATIC AND HETEROCYCLIC RADICALS IN FERROCENE. REACTION OF BROMO FERROCENE WITH ORGANIC MAGNESIUM COMPOUNDS
A. N. Nesmeyanov, V. A. Sazonova, and V. N. Drozd 27 Jun. 1966 10 p refs Transl. into ENGLISH from Dokl. Khim. Akad. Nauk SSSR (Moscow), v. 165, no. 3, 1965
(RSIC-573; TT-66-61900; AD-636566) CFSTI: HC $1.00/MF $0.50

When an ether solution of Grignard reagent was added to a mixture of bromo ferrocene, cuprous bromide, and copper, the ether distilled, and the reaction mixture heated under nitrogen at 130°C, phenyl-alpha-thienyl- and alpha-naphthyl-ferrocenes were obtained with a yield of 75%–80%. The reaction proceded differently in the case of the allylic Grignard reagent, chlorous cyclohexylmagnesium; the reaction basically became a conversion of bromo ferrocene to ferrocene, and cyclohexene was also extracted from the reaction mixture. A mixture of alpha- and beta-pyrrole-ferrocenes was created during the interaction of bromo ferrocene with bromine pyrrole magnesium in the presence of Cu_2Br_2+Cu. Idolyl bromide behaved somewhat differently in this reaction: N- and beta-indolyl-ferrocenes were produced. The structures of the compounds obtained were determined on the basis of N.M.R. spectra. TAB

N66-37249# RAND Corp., Santa Monica, Calif.
ON MEMBRANE EQUILIBRIA
N. Z. Shapiro and L. S. Shapley Jul. 1966 68 p refs
(Contract AF 49(638)-1700; Proj. RAND)
(RM-4464-PR; AD-636605) CFSTI: HC $3.00/MF $0.75

The study mathematically investigated equilibrium properties of certain two-phase chemical systems. The different types of equilibrium compositions and the conditions that govern them are determined. The effects of linear variation in the chemical inputs are studied; e.g., the effects on a multi-substance fluid, separated by a semipermeable membrane, to which another fluid is slowly added. Among other results, it is shown that the relative sizes of the two phases will always change monotonically, but that the absolute sizes may fluctuate. Author (TAB)

N66-37275*# National Bureau of Standards, Washington, D. C. Inst. for Basic Standards.
ELECTROCHEMICAL DATA, PART III Quarterly Report, 1 Apr.–30 Jun. 1966
Harold J. De Wane and Walter J. Hamer 15 Aug. 1966 11 p refs
(NASA Order R-09-022-029)
(NASA-CR-78145; NBS-9394) CFSTI: HC $1.00/MF $0.50 CSCL 07D

Tabulated data are presented on the equivalent conductance of hydrochloric acid at 25° C. at rounded concentrations between 1.0×10^{-4} and 11.6 N in absolute mhos. Similar data are also given on the values of Λ_o and J of hydrochloric acid at 25°C. M.G.J.

N66-37286*# Whittaker Corp., San Diego, Calif. Narmco Research and Development Div.
ELECTROCHEMICAL CHARACTERIZATION OF SYSTEMS FOR SECONDARY BATTERY APPLICATION First Quarterly Report, May–Jul. 1966
M. Shaw and A. H. Remanick 17 Aug. 1966 116 p refs
(Contract NAS3-8509)
(NASA-CR-72069) CFSTI: HC $3.00/MF $1.00 CSCL 07D

Fifty-one electrochemical systems comprising silver, copper, and nickel in fluoride- or chloride-containing solvents such as butyrolactone, propylene carbonate, acetonitrile, and dimethylformamide, were evaluated in a molecular level screening program using multi-sweep cyclic voltammetry. Chemical characterization of materials is in progress. Author

N66-37287*# IIT Research Inst., Chicago, Ill. Technology Center.
PURIFICATION OF GEMINI FUEL CELL WATER BY ION-EXCHANGE CHROMATOGRAPHY Final Report, 13 Apr.–12 Nov. 1965
Hugh J. O'Neill 22 Dec. 1965 40 p
(Contract NAS9-4107)
(NASA-CR-65530; IITRI-U6019-7) CFSTI: HC $2.00/MF $0.50 CSCL 07C

The objective of this program was to apply ion-exchange chromatography to the purification of Gemini fuel cell water. Thirteen selected resin beds were evaluated in both mono- and multibed combinations. Charcoal adsorbents were screened for their removal of hydroquinones, which were responsible for the water color. However, the subsequent use of a strong-base macroreticular anion-exchange resin for the removal of sulfonic acids also performed this function quite well and therefore eliminated the need for charcoal. The system that has the best selectivity toward the organic and inorganic constituents in the fuel cell water consists of a mixed bed of resins IRA-904, IRA-68, IRC-84, IR-45, and IR-120. Bed radios and projected bed weights both for a nominal and an optimal bed system employing a 2.5x reliability factor are reported. Author

N66-37304*# American Univ., Washington, D. C.
INVESTIGATION OF ELECTROCHEMISTRY OF HIGH ENERGY COMPOUNDS IN ORGANIC ELECTROLYTES. BIBLIOGRAPHY ON PROPYLENE CARBONATE, γ-BUTYROLACTONE, AND RELATED SUBJECTS Supplement to Third Progress Report
J. P. Marciniszyn, Jr. and R. T. Foley 12 Sep. 1966 55 p refs
(Grant NGR-09-003-005)
(NASA-CR-78235) CFSTI: HC $2.50/MF $0.50 CSCL 07C

This bibliography lists references in the open literature that will assist in investigations of the electrochemistry of high energy compounds in organic electrolytes. Included are references on lactones, and the purification, properties, synthesis, and reactions of butyrolactones. H.S.W.

N66-37311*# Miami Univ., Coral Gables, Fla. Inst. of Molecular Evolution.
CONDENSATION OF CYTIDYLIC ACID IN THE PRESENCE OF POLYPHOSPHORIC ACID
Alan W. Schwartz and Sidney W. Fox [1966] 19 p refs Submitted for Publication Prepared in cooperation with Fla. State Univ.
(Grant NsG-689)
(NASA-CR-78240) CFSTI: HC $1.00/MF $0.50 CSCL 08A

The partial structure characterization of the oligomeric-mixture obtained from cytidine-2'(3')-phosphate and polyphosphoric acid is reported. A single 2'(3')-P-terminal end group was found per chain. Although resistant linkages were detected, recovery of starting material from mild alkaline hydrolysis indicated that the linkages were predominantly 2'(3')-phosphodiester in nature. The presence of 3'-phosphodiester linkages was demonstrated by hydrolysis with bovine pancreatic ribonuclease, and 5'-phosphodiester linkages were detected by hydrolysis with venom phosphodiesterase. H.S.W.

N66-37390# Picatinny Arsenal, Dover, N. J. Plastics and Packaging Lab.

HALOGENATED EPOXY TYPE RESINS. I: PREPARATION AND DETERMINATION OF STRUCTURE OF HALOGENATED BISPHENOL-TYPE COMPOUNDS

Walter J. Erich, Frederick S. Holahan, and Richard J. Valles Jul. 1966 29 p refs

(PA-TR-3328; AD-636141) CFSTI: HC $2.00/MF $0.50

The tetrabromo and tetrachloro derivatives of three parent compounds—bisphenol A, Hexafluoroacetone bisphenol, and tetrafluorodichloroacetone bisphenol—were prepared. Elemental analyses were good in general and strongly indicated that the compounds were tetrahalogenated. Nuclear magnetic resonance studies proved that the compounds contained four symmetrical halogens. Infared studies conclusively proved, by analogy with known model compounds, that the halogens were in the 2,6 rather than the 3,5 position. The melting points of the tetrabromo derivatives were, in general, considerably higher than those of the parent compounds, but in two instances the tetrachloro derivatives gave lower readings than the parent compounds. The reason for this difference is not known. Author (TAB)

N66-37429# National Research Corp., Cambridge, Mass. Norton Exploratory Research Div.

THERMOCHEMISTRY OF SELECTED COMPOUNDS Quarterly Letter Report, 15 Feb.–15 May 1966

Ludwig G. Fasolino 15 Jun. 1966 5 p

(Contract Nonr-3608(00))

(Rept.-5108-1-03608; AD-635825) CFSTI: HC $1.00/MF $0.50

Hydrolysis studies of aluminum borohydride were continued and an attempt was made to locate the source of the contributing factor which resulted in the scatter of the heat data. It is felt that the main factor was the lack of proper control of the jacket temperature which is held at 2°C. Measures were taken to monitor and to correct the deviation of this temperature from a fixed setting. TAB

N66-37457# Colorado Univ., Boulder.

THE SYNTHESIS OF SPECIAL FLUORINE-CONTAINING MONOMERS Final Report, 1 Oct. 1963–1 Oct. 1965

J. D. Park and J. R. Lachner Jan. 1966 117 p refs *Its* Tech. Rept.-66-54-CM

(Contract DA-19-129-QM-126)

(C&OM-17; AD-636217) CFSTI: HC $4.00/MF $0.75

A large number of fluorine containing intermediates were synthesized and shipped for further polymer studies. Among the organic fluorine compounds synthesized were: (a) various bicyclobutenyl derivatives, (b) Grignard reaction products and pyrolysis materials obtained therefrom, (c) unsaturated fluorine-containing halogenated (Br, Cl, I) cyclobutenes and (d) various α, ω-diolefins. Most of the above compounds were new to the arts. Author (TAB)

N66-37461# Barcelona Univ. (Spain).

SYNTHESIS AND PROPERTIES OF ALKAROMATIC CHLOROCARBONS Annual Summary Report, 1 Nov. 1964–31 Oct. 1965

Manuel Ballester Wright-Patterson AFB, Ohio, ARL, Apr. 1966 21 p refs

(Contract AF 61(052)-749)

(ARL-66-0070; AD-636161) CFSTI: HC $1.00/MF $0.50

Progress in the alkaromatic chlorocarbons is summarized, including informational exchanges, papers presented and published, and patent history. Recent data obtained from the synthesis and reactivity studies on the new class of inert perchlorocarbon free radicals are described. These include results obtained with perchlorodiphenylmethyl, perchlorotriphenylmethyl, perchloro-4-phenyldiphenylmethyl, perchloro-4-phenyltriphenlmethyl, perchloro-α, α, α, α-tetraphenylbi-p-tolyl-α, α-ylene diradical, αh, αh, αh-tetradecachloro-4-methyltriphenylmethyl radicals and related compounds. These radicals are chemically inert to oxygen and halogens, due principally to steric hindrance, but give sharp electron spin resonance lines. Author (TAB)

N66-37548# Naval Radiological Defense Lab., San Francisco, Calif.

ADSORPTION OF LANTHANUM BY NAVY GRAY PAINTED SURFACES

Robert N. Anderson and Robert M. Railey 28 Mar. 1966 70 p refs

(USNRDL-TR-1013; AD-486073)

Lanthanum adsorption by gray paint surfaces and by powdered TiO_2 was studied as a function of lanthanum concentration, pH, and inert electrolyte concentration and for the paint only as a function of contact time. Lanthanum adsorption was measured by use of the radiotracer La^{140}. The paint was found to readily adsorb lanthanum up to approximately 3×10^{-6} g/cm^2, while adsorption by the TiO_2 was very small and could not account for the adsorptivity of the paint. Author

N66-37550# United Kingdom Atomic Energy Authority, Windscale (England). Production Group.

ANALYTICAL METHOD FOR THE ABSORPTIOMETRIC DETERMINATION OF IRON IN HIGH PURITY PLUTONIUM METAL (BATHOPHENANTHROLINE METHOD)

1966 11 p

(PG-729(W)) HMSO: 1s 3d

Iron is extracted into chloroform as the tris-bathophenanthroline ferrous complex from a solution of the sample containing EDTA. The absorbancy of the complex is measured on a Spekker absorptiometer. Author

N66-37553# United Kingdom Atomic Energy Authority, Harwell (England) Chemistry Div.

STUDIES OF THE EQUILIBRIUM METAL VAPOUR PRESSURES OVER THE ALKALINE EARTH CARBIDES. PART 2: CaC_2

R. L. Faircloth, R. H. Flowers, and F. C. W. Pummery Jun. 1966 13 p refs

(AERE-M-1771) CFSTI: HC $1.00/ MF $0.50

A pure sample of CaC_2 has been synthesized from its elements, and the pressure of Ca vapor in equilibrium with it in the temperature range of 1300°–1900° K has been measured by the Knudsen effusion method. A value of $\Delta H°_{298}(f)$ for CaC_2 is derived and compared with corresponding results for SrC_2 and BaC_2. Author

N66-37583*# National Bureau of Standards, Washington, D.C.

A SURVEY OF THERMODYNAMIC PROPERTIES OF THE COMPOUNDS OF THE ELEMENTS CHNOPS Eighth Progress Report, 1 Apr.–30 Jun. 1966

George T. Furukawa, Martin L. Reilly, George T. Armstrong, Gerald D. Mitchell, and Iva Halow 15 Jul. 1966 119 p refs (NASA Order R-138)

(NASA-CR-78337; NBS-9374) CFSTI: HC $4.00/MF $1.00 CSCL 07D

Tables of the thermodynamic properties of certain carbon, hydrogen, nitrogen, oxygen, phosphorus, and sulfur compounds are presented. The tables contain the name and phase of the substance, a statement of the energy and temperature units used, the molecular weight, a list of standard thermodynamic changes on formation from the elements, along with suitable headings and a tabulation of standard thermodynamic functions. A review of the heats of formation and other properties of benzene, napthalene, anthracene, and phenanthrene is also included. Selected values of enthalpy of formation and Gibbs energy of formation are tabulated for these substances in the condensed and the gaseous phases. H.S.W.

N66-37595# Societa Ricerche Impianti Nucleari, Saluggia (Italy). Centro Ricerche Nucleari.

CONTINUOUS MEASUREMENT OF GASEOUS MIXTURES BY THE ABSORPTION OF WEAK X-RAYS [MESURE EN CONTINU DE LA CONCENTRATION DE MELANGES GAZEUX PAR L'ABSORPTION DES RAYONS X MOUS]

A. Bruna and P. G. Caldera 1966 21 p ref Presented at the Study Sessions on the Use of Radioelem. in Chem. and Petrol. Ind., Marseille 16–17 Jun. 1966 Supported by EURATOM (SORIN-93) CFSTI: HC $1.00/MF $0.50

For industrial application, the physical properties of a mixture of silicochloroform with hydrogen were examined by a weak X-ray absorption technique. Using selective X-ray absorption, a prototype apparatus capable of continuous analysis of a 1–10% molar concentration of $SiHCl_3$ was assembled. The equipment, consisting of a measurement counter, X-ray source, radiation detector, and related electronic equipment, is considered to be of excellent precision and sensitivity, and is corrosion resistant. Transl. by R.LI.

07 COMMUNICATIONS

Includes communications equipment and techniques; noise; radio and communications blackout; modulation telemetry; tracking radar and optical observation; and wave propagation. For basic research see: 23 Physics, General; and 21 Navigation.

N66-36501# Eidgenossische Technische Hochschule, Zurich (Switzerland).

NOISE THRESHOLD IN FM-RECEIVING SYSTEMS ESPECIALLY SYSTEMS APPLYING NEGATIVE FREQUENCY-FEEDBACK [UEBER DIE GRENZEN BEIM EMPFANG FREQUENZ-MODULIERTER SIGNALE, INSBESONDERE BEI DER ANWENDUNG EINER FREQUENZGEGENKOPPLUNG]

Peter Frutiger (Ph.D. Thesis) 1965 122 p refs In GERMAN; ENGLISH summary

(Rept.-3693) CFSTI: HC $4.00/MF $1.00

The purpose of the investigation is to shed light on the physical effects responsible for the threshold behaviour of FM-receiving Systems especially those applying negative frequency feedback (FFM-Systems) and to obtain quantitative relations for optimal design of such systems. First a new method is applied to the description of threshold effects in conventional FM-receivers giving access to the phenomena implied in a more lucid and mathematically simpler manner than obtained by previous theoretical investigations of other authors. By employing suitable approximations the output spectra and signal to noise ratios can be derived from the amplitude distribution of the noise envelope. The mathematical expressions obtained are relatively simple and well suited to numerical evaluation. Numerical calculations carried out by computer agree very well with results in the literature available for some relatively restricted cases. The new method is then applied to the much more involved problem of the output noise spectra at and below threshold of a FM-receiving system with negative frequency feedback which can hardly be solved by conventional rigid mathematical methods. The results obtained are shown to be in full agreement with measurements carried out on different systems. Author

N66-36507# Collins Radio Co., Dallas, Tex.

COMMUNICATIONS SYSTEMS UTILIZING PASSIVE SATELLITES

Robert T. Hart *In* Canaveral Council of Tech. Soc. 3d Space Congr. 1966 p 1–20 refs (See N66-36506 22-30)

The history of the passive satellite communications experiments to date and solutions to the deficiencies that have been indicated are presented. The solutions include a preview of studies of new materials and satellite configurations. Communications system capability utilizing the proposed satellites is detailed for conventional and specialized networks. Author

N66-36508# Bourns, Inc., Ames, Iowa.

SPACECRAFT COMMUNICATIONS SYSTEMS DESIGN STEPS

William Benner *In* Canaveral Council of Tech. Soc. 3d Space Congr. 1966 p 21–32 (See N66-36506 22-30)

A systematic approach to the design of communications systems for major spacecraft programs is presented. Communications are defined not only as two-way voice with earth, but also commands to the spacecraft; telemetry; voice-links with other spacecraft, external crew members and internal intercom; and space-borne portions of the radar tracking links. The eight design steps considered in sequence are to: establish the necessary communication links; make the choice of optimum frequencies; establish minimum signal levels; determine the data to be carried by specified links; determine optimum modulation techniques for voice, telemetry, command link, and possible TV link; choose trade-offs of number of transmitters and power levels; consider antenna physical configurations; and compare final system and subsystem trade-offs in terms of reliability, power consumption, weight, and cost. S.P.

N66-36509# ITT Federal Labs., San Fernando, Calif.

OPTICAL SUBCARRIER COMMUNICATIONS

J. H. Ward, III and M. L. Shechet *In* Canaveral Council of Tech. Soc. 3d Space Congr. 1966 p 33–50 refs (See N66-36506 22-30)

The use of rf subcarriers placed on optical beams for communication purposes is discussed. Through the use of advanced optical beam processing and post detection electronic processing, the advantages of optical frequency techniques can be combined with the mature background of the rf technology. These techniques are expected to find applications for long range wideband communication, spacecraft tracking and rendezvous, and altimetry, as well as for aircraft and spacecraft landing aids. Author

N66-36510# Goodyear Aerospace Corp., Akron, Ohio.
ADVANCED TRACKING AND COMMUNICATION SATELLITES
C. M. Kelly and W. C. Reynolds *In* Canaveral Council of Tech. Soc. 3d Space Congr. 1966 p 51–68 refs (See N66-36506 22-30)

Details are presented for a synchronous-orbit tracking and communications satellite system, which uses a large electronically steered antenna in conjunction with tracking interferometers and low-powered solid state transmitter-receiver components. The satellite uses the spherical reflector and the associated packaging and deployment techniques that were tested for passive communication satellite programs. Tracking satellite attitude and yaw angle are determined at the master ground terminal from signals radiated from the uhf satellite interferometer antennas and polarization vector of the X-band antenna signal respectively. Data concerning the electronic system, satellite configuration, payload weight and volume, tracking accuracy, system coverage, antenna beam steering, system trades, data links, ground terminal, and other satellite applications are included. S.P.

N66-36533# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
EVOLUTION OF SATELLITE PFM ENCODING SYSTEMS FROM 1960 TO 1965
Hosea D. White, Jr. *In* Canaveral Council of Tech. Soc. 3d Space Congr. 1966 p 361–369 refs (See N66-36506 22-30)

Expansion of the pulse frequency modulation over a 5-year period encoding system to encompass more spacecraft electronic functions in a central package and to incorporate hardware is discussed. This expansion has enabled much of the time correction and error detection to be done by computer programming on the gound. The functional complexity of the encoding system is shown to have increased by a factor of 20 from Explorer XII (designed in 1960) to IMP F (designed in 1965); yet the volume has remained about the same, and low power (about 1.2 watts) has been maintained. The circuit design approaches taken in Super IMP are analyzed; and the evolution of the Super IMP encoding system is described. Incorporation of such items as digital data processors, analog-to-digital converters, improved commutation, increased efficiency with crystal-controlled digital oscillators, and a 30-day satellite clock is described. S.P.

N66-36535# Radio Corp. of America, Moorestown, N. J. Missile and Surface Radar Div.
TIME CORRELATED DATA RETRANSMISSION TELEMETRY SYSTEM
Edward L. Keohane *In* Canaveral Council of Tech. Soc. 3d Space Congr. 1966 p 387–395 (See N66-36506 22-30)

The paper describes techniques for the development of a time correlated burst retransmission telemetry system. The discussion covers the feasibility of a time correlated system and considerations for its implementation. The many dependent and independent parameters encountered and their effect on the overall system requirements are examined. Formatting techniques of the output link which provides the capability of extracting data and time events while maintaining a high bandwidth efficiency is presented. A three-input link system (Gemini, Agena and Titan) having one output link will be examined. The advantages and disadvantages of the burst system will be evaluated resulting in the selection of the system which is most applicable to the mission requirement. Author

N66-36536# Radio Corp. of America, Moorestown, N. J. Missile and Surface Radar Div.
APPLICATION OF GENERAL PURPOSE COMPUTER TECHNIQUES TO THE DESIGN OF A PROGRAMMABLE PCM TELEMETRY DECOMMUTATOR
D. J. Herman and J. O. Horsley *In* Canaveral Council of Tech. Soc. 3d Space Congr. 1966 p 396–408 refs (See N66-36506 22-30)

This paper describes design of a programmable decommutator for multiformat PCM telemetry data. The decommutator organization includes a program counter, instruction decoding registers, and an arithmetic unit, together with pattern comparison logic, and synchronization decision networks. The various types of input formats are discussed and their implications on the organization are determined. The input data formats include: (a) normal PCM commutation with frame synchronization and subcommutation synchronization, (b) mixes of different rate PCM commutation, (c) word synchronization and (d) data address tags with each data word. The decommutator is organized around a coincident current memory which serves for both program storage and data buffering. A system of program interrupts is also provided so that: (a) data words can be requested from the buffer by an asynchronous device, and (b) new programs can be loaded into unused sections of memory. The address and control fields of the program instructions are defined to allow all of the synchronization parameters (i.e., error tolerance) to be contained as part of the program. Author

N66-36668# Joint Publications Research Service, Washington, D. C.
TWENTY-SECOND ALL-UNION SCIENTIFIC SESSION DEVOTED TO RADIO DAY. SECTION ON TELEMECHANICS
18 Aug. 1966 179 p refs Transl. into ENGLISH of the publ. "XXII Vsesoyuznaya Nauchnaya Sessiya, Posvyashchennaya Dnyu Radio. Sektsiya Telemekhanik" Moscow, 1966 p 3–108 (JPRS-37085; TT-66-33514) CFSTI: $5.00

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N66-36667# Joint Publications Research Service, Washington, D. C.

METHODS OF EVALUATING NOISE IMMUNITY AND THE EFFECTIVENESS OF TELECONTROL ADDRESS SYSTEMS

V. M. Pomazan *In its* 22d All-Union Sci. Session Devoted to Radio Day. Sect. on Telemech. 18 Aug. 1966 p 1–17 refs (See N66-36666 22-07) CFSTI: $5.00

An evaluation is made of telecontrol address systems for which simultaneous messages are sent from (1) the control post to the object and (2) to the memory unit of the control post. Noise immunity and effectiveness of transmission are evaluated by the following criteria: (1) the probability of error detected but not corrected, (2) the probability of at least one undetected error, and (3) the average number of repetitions attributable to a single transmission command. To evaluate noise immunity under waiting conditions, the probability of one undetected error during the waiting period and the time to transmit a code combination is employed. It is assumed that a specific code combination stands for the object-selecting command and for execution of the operation at the object; and that the direct channel and the feedback information channel use the same code. A transition-probability matrix characterizes transmission over a channel. The necessary formulas are evolved, and an example is included. M.W.R.

N66-36668# Joint Publications Research Service, Washington, D. C.

OPTIMAL DISCRETE REPRESENTATION OF RANDOM PROCESSES IN INFORMATION SYSTEMS

A. P. Manovtsev *In its* 22d All-Union Sci. Session Devoted to Radio Day. Sect. on Telemech. 18 Aug. 1966 p 18–24 refs (See N66-36666 22-07) CFSTI: $5.00

Optimization conditions and selection of the representation class are considered in a discussion dealing with the optimal discrete representation of random processes in information systems. Indices of accuracy in process reproduction are discussed, along with coordinate-generating methods and their basic relations. Attention is given to optimum coordinates and to the development of theory necessary for defining optimization conditions. M.W.R.

N66-36669# Joint Publications Research Service, Washington, D. C.

ON THE QUESTION OF SYNTHESIZING LINEAR BURST ERROR-CORRECTING CODES

R. P. Mergelishvili *In its* 22d All-Union Sci. Session Devoted to Radio Day. Sect. on Telemech. 18 Aug. 1966 p 25–29 (See N66-36666 22-07) CFSTI: $5.00

A formulation is presented for the code distance which permits the solution of linear coding problems with errors in the form of bursts of given length and rate. The results are considered applicable to independent errors and multiple error bursts in communication systems. The principle of recurrent code construction is given for the synthesis of linear codes to correct multiple error bursts. M.W.R.

N66-36670# Joint Publications Research Service, Washington, D. C.

ON THE EFFECTIVENESS OF METHODS OF SELECTION AND CODE GENERATION IN TELEMECHANICS

F. A. Katkov *In its* 22d All-Union Sci. Session Devoted to Radio Day. Sect. on Telemech. 18 Aug. 1966 p 30–42 refs (See N66-36666 22-07) CFSTI: $5.00

Effectiveness of frequency, distributive, and combination methods for selection and generation of codes is discussed, along with the effectiveness of codes during the transmission of single code circuits, and during serial transmission of code combinations. Code combinations of irreducible codes can be transmitted serially without separating pauses, but other types of combination codes require pauses. It is shown that the irreducible changeable-sample code with group selection during serial transmission of code combinations is 1.4 times as effective as the time binary start–stop code employed in telegraph equipment. Effectiveness of irreducible changeable-quality codes is shown to be 1.4 times lower than the start–stop code and 2 times lower than the changeable-sample code with group selection. M.W.R.

N66-36671# Joint Publication Research Service, Washington, D. C.

ON THE CHOICE OF A DATA TRANSMISSION SYSTEM

K. A. Smirnov *In its* 22d All-Union Sci. Session Devoted to Radio Day. Sect. on Telemech. 18 Aug. 1966 p 43–48 refs (See N66-36666 22-07) CFSTI: $5.00

Transmission with decision feedback and with information feedback is discussed for telegraph channels, and a comparative analysis is made of the two kinds of feedback on the basis of cycling probability. The model channel is assumed to have errors grouped into bursts with Poisson time distribution, and the distribution of error bursts by duration is geometric. It is noted that decision feedback systems require the introduction of character-by-character and group redundancy. On the basis of the analysis, it is concluded to be inadvisable to use systems with block correction greater than 25 characters and error probability of 10^{-3}. M.W.R.

N66-36672# Joint Publications Research Service, Washington, D. C.

CODES WHICH ARE NOISEPROOF ACCORDING TO MINIMAX CRITERION

G. A. Shastova and V. M. Pomazan *In its* 22d All-Union Sci. Session Devoted to Radio Day. Sect. on Telemech. 18 Aug. 1966 p 49–64 refs (See N66-36666 22-07) CFSTI: $5.00

A mathematical model of error rate in remote-control systems is presented in which the bad state of a channel may have a specified random error probability which is constant for one state but varies from state to state. The code for which maximum error is minimal is considered to be more noise-proof, and such criterion for evaluating noise immunity is called the minimax criterion. This minimax criterion is considered advisable for use during the selection of a code for the transmission of crucial information, mainly in systems with a feedback channel. Investigations indicate a rise in the noise immunity of binary codes is attained by increasing code redundancy; and the probabilities of various errors for certain redundant error-correction codes are determined. A formula is given for determining the average probability of generating any false information under waiting conditions. M.W.R.

N66-36673# Joint Publications Research Service, Washington, D. C.

ELEMENT-BY-ELEMENT RECEPTION OF ADDRESS INFORMATION

L. B. Benchkovskiy and V. A. Kashirin *In its* 22d All-Union Sci. Session Devoted to Radio Day. Sect. on Telemech. 18 Aug. 1966 p 65–73 ref (See N66-36666 22-07) CFSTI: $5.00

Increasing noise immunity of address-information transmission in telemechanics is accomplished through the use of a priori information regarding the address of the object in question. It is shown that the probability of false-command generation can be lowered significantly via increasing command suppression or fail-safe action, and the probability of a single-pulse distortion is graphed. In effect, false choice of an object during the transmission of address information is accomplished through the use of a variable cycle-by-cycle threshold in the receiver unit. M.W.R.

N66-36674# Joint Publications Research Service, Washington, D. C.

ON THE COMBINATION PROPERTIES OF REMOTE-CONTROL CODES

V. A. Stulov *In its* 22d All-Union Sci. Session Devoted to Radio Day. Sect. on Telemech. 18 Aug. 1966 p 74–78 refs (See N66-36666 22-07) CFSTI: $5.00

An overview is presented of different code combinations obtained by combining the value of characters, and the code base is considered to be the number of the values of the characters. If a code combination consists of one multi-element sample, then several elements can be transmitted simultaneously. The alphabets for all parallel components can be either identical or different. It is noted that the codes widely used at present employ code combinations consisting of single-element samples, or just one sample with parallel transmission of code elements. M.W.R.

N66-36675# Joint Publications Research Service, Washington, D. C.

SOME PROBLEMS IN THE RECEPTION AND PROCESSING OF COMPOUND BINARY SIGNALS IN ASYNCHRONOUS RADIOTELEMECHANICAL SYSTEMS

I. M. Romanov and T. K. Nezhmetdinov *In its* 22d All-Union Sci. Session Devoted to Radio Day. Sect. on Telemech. 18 Aug. 1966 p 79–84 refs (See N66-36666 22-07) CFSTI: $5.00

Various aspects of the design and servicing of asynchronous radiotelemechanical systems are discussed. The receiving apparatuses of such systems are usually designed to receive discrete signals in a wide dynamic band of amplitudes, and the threshold signal level which triggers the actuating mechanism far exceeds the level of the noise fluctuations. It is noted that in asynchronous systems, the processes connected with reception and processing of signals cannot be controlled by commands of the programming device that are produced in the receiving apparatus alone. A formula is given for the probability of the correct reception and processing of a compound signal as a whole, but other probability formulas are omitted. M.W.R.

N66-36678# Joint Publications Research Service, Washington, D. C.

ON CALCULATING THE RELIABILITY OF TELEMECHANICAL DEVICES

K. G. Mityushkin and I. V. Prangishvili *In its* 22d All-Union Sci. Session Devoted to Radio Day. Sect. on Telemech. 18 Aug. 1966 p 102–108 (See N66-36666 22-07) CFSTI: $5.00

The interconnection of various elements in telemechanical devices is considered the structural basis for the calculation of reliability. Coefficients of importance of elements are mentioned as being important for accurate characterization of reliability. It is noted that calculation of these importance coefficients emphasizes the fact that increasing the number of elements does not always decrease system reliability. Device reliability is defined in terms of performance, and the coefficients of importance are used in predicting device performance. M.W.R.

N66-36679# Joint Publications Research Service, Washington, D. C.

THE RECEPTION OF MULTIFREQUENCY TELEMECHANICAL SIGNALS

A. B. Popov *In its* 22nd All-Union Sci. Session Devoted to Radio Day. Sect. on Telemech. 18 Aug. 1966 p 110–117 (See N66-36666 22-07) CFSTI: $5.00

On the basis of experimental findings, which are presented in graphical form, it is concluded that a receiver of telemechanical frequency signals and with a compensating-bias circuit may operate by stabilization of either the (1) frequency selector output voltage level or (2) transmission bandwidth at the triggering level of the output threshold device. In the latter case, the output voltage of the frequency selector increases somewhat, but to a lesser extent than in the absence of a compensating-bias circuit. Compensating-bias voltage, resulting from either type of stabilization, is associated with the input signal level. It is shown that if input-signal level increases, the compensating-bias voltage continues to increase even when the frequency-selector channel enters a limiting regime. This results in cutting off the output of all frequency selectors and, therefore, rules out the possibility of false triggering from very powerful signals or noise. M.W.R.

N66-36792# Army Engineer Geodesy, Intelligence and Mapping Research and Development Agency, Fort Belvoir, Va.

A GEOMETRIC SIMULTANEOUS MULTISTATION DETERMINATION, WITH CONSTRAINTS, USING DATA FROM GEODETIC SATELLITES

Lawrence A. Gambino (1964) 16 p refs (AD-634679) CFSTI: HC $1.00/MF $0.50

The optical and electronic data gathered from observations on geodetic satellites can be used in a simultaneous determination of all points on a trajectory along with the determination of the three dimensional coordinates of ground stations.

Unlike other reductions in which the equations from all ground stations to a single trajectory point would be performed in a stepwise fashion, the procedure to be outlined assumes that the individual trajectory points are not mutually independent quantities. With this approach, a simultaneous, multistation, least square solution is performed. The entire matrix treatment of the multistation problem is not presented in this paper. Instead, much of the development is a heuristic treatment of the problem. TAB

N66-36836# Joint Publications Research Service, Washington, D. C.
AUTOMATION AND TELEMETRY IN SPACE MEDICINE
A. Kalinovskiy *In its* Develop. in the USSR Space Program 29 Aug. 1966 p 1–6 (See N66-36835 22-30) CFSTI: $1.00

The operational medical monitoring and subsequent processing of the medical–biological information from manned space flights are discussed. The designs of systems for on board medical monitoring and graphic processing of data coming from space by radiotelemetric channels are described, and block diagrams of the systems are given. It is concluded that wide introduction of automated systems for information processing and the use of improved data analysis methods and equipment will significantly further space exploration programs. A.G.O.

N66-36855*# Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena.
GROUND INSTRUMENTATION FOR MARINER IV OCCULTATION EXPERIMENT
G. S. Levy, T. Y. Otoshi, and B. L. Seidel 15 Sep. 1966 32 p refs
(Contract NAS7-100)
(NASA-CR-78051; JPL-TR-32-984) CFSTI: HC $2.00/MF $0.50 CSCL 17B

Principal quantities measured at the Deep Space Instrumentation Facility (DSIF) receiver stations during the Mariner IV occultation experiments were doppler frequency, rf phase, and signal strength as a function of time. Unique demands were placed on the receiver equipment since it was necessary to measure extremely small deviations in the rate of change of frequency. In order to utilize the short-duration occultation signals, predicted to be between 20 sec and 2 min, magnetic tape recordings were made for later processing. Details are presented for the DSIF radio system; and tests results included are phase-lock-loop receiver tests, open-loop occultation receiver tests, spacecraft transponder acquisition-time tests, and simulation of expected amplitude modulation. M.W.R.

N66-36860*# Illinois Univ., Urbana. Antenna Lab.
A TECHNIQUE FOR SOLVING CERTAIN WIENER–HOPF TYPE BOUNDARY VALVE PROBLEMS Technical Report No. 9
C. P. Bates and R. Mittra May 1966 113 p refs *Its* Antenna Lab. Rept.-66-4
(Grant NsG-395; Contract AF 19(628)-3819)
(NASA-CR-78116; AFCRL-66-352; AD-635774) CFSTI: HC $4.00/MF $0.75 CSCL 20N

The time-harmonic analysis of three boundary value problems containing semi-infinite boundaries is presented. The first problem considered is a parallel plate waveguide with one plate truncated and radiating into free space. The excitation of a dielectric slab and the excitation of an isotropic, incompressible, plasma slab by means of a parallel plate waveguide with one plate truncated are the second and third problems analyzed, respectively. A function of a complex variable is factored in each of these Wiener–Hopf type boundary value problems. The function is analytic in a strip and is factored into a product of two functions. One of these functions is analytic in a half-plane while the other is analytic in the adjacent half-plane with an overlap in the regions of analyticity coinciding with the strip. This factorization is obtained by a technique developed in this work. The technique obtains the factorization for the open-region problem from a function and its factorization that occurs in a related closed-region problem. A closed-region problem is one whose transverse dimensions are finite. The chosen closed-region boundary value problem yields a function of a complex variable which can be factored. The factorization of the function for the open-region boundary value problem is obtained by taking the limit, as a parameter approaches infinity, of the function and factorization appropriate to the closed-region structure. By this means the factorization and hence the solution to the open-region boundary value problem is obtained. TAB

N66-36911# Army Electronics Labs., Fort Monmouth, N. J.
MODULAR ORGANIZATION FOR NODES IN AN ADAPTIVE HOMOSTATIC PROCESS-ORIENTED COMMUNICATIONS SYSTEM
Robert M. Dunn Jun. 1966 26 p refs
(ECOM-2722; AD-636266) CFSTI: HC $2.00/MF $0.50

A modular organization for a communications network node is proposed. Its principal bases are: (1) message format for all information; (2) saturation processing; and (3) a limited purpose, memory-oriented processor. Philosophical principles and a formal model for the system are reviewed. The organization is then presented after a brief discussion of some significant technical assumptions. This is followed by a review of a few possible consequences of the proposed organization. In addition to any possible significance towards immediate system design, the discussion ends with the conclusion that the proposed organization is an indicator of a necessary future direction for Army communications systems development. Author (TAB)

N66-36917# Lincoln Lab., Mass. Inst. of Tech., Lexington.
LINCOLN EXPERIMENTAL TERMINAL
Paul Rosen, Ralph V. Wood, Jr., and Burt E. Nichols 11 May 1966 17 p refs *Its* Tech. Note 1966–30
(Contract AF 19(628)-5167)
(ESD-TR-66-206; AD-636280) CFSTI: HC $1.00/MF $0.50

The Lincoln experimental terminal is a complete, self-contained air-transportable ground terminal for testing and demonstrating evolving space communication techniques in a realistic environment. Its present equipment complement permits efficient, highly reliable, multiplexed digital communication of voice and record traffic using a variety of channels, including the moon and active satellites. Its modulation system, using a 16-symbol alphabet frequency-hopped over a 20-mcps band, together with efficient coding, provides multiple-access use of a wide-band satellite. Author (TAB)

N66-37056# Inter-Range Instrumentation Group, White Sands Missile Range, N. Mex. Telemetry Working Group.
TELEMETRY STANDARDS
Apr. 1966 102 p Revised
(IRIG-106-66; AD-635857) CFSTI: HC $4.00/MF $0.75

It is the purpose of this revision to delineate the obtainable performance of modern telemetry systems within the limits of practical design and use. These standards, therefore, do not necessarily define the existing capability of any test range but, rather, constitute a guide for the implementation and orderly application of telemetry systems for both the ranges

and range users within the limits of good design practice. The broader range of capabilities attainable under these standards requires more careful consideration of tradeoffs (e.g., frequency response versus accuracy) than heretofore. Guidance to the user in this consideration is provided in the appropriate appendices to these standards. These telemetry standards were established to further the compatibility of airborne transmitting equipment and ground receiving and data-handling equipment at the test ranges. TAB

N66-37060# Georgia Inst. of Tech., Atlanta. Engineering Experiment Station.

STUDY AND ANALYSIS OF SPEECH PARAMETERS AND BANDWIDTH COMPRESSION TECHNIQUES Final Report, 1 Jul. 1965–30 Jun. 1966

Barry O. Pyron and Frank R. Williamson, Jr. 25 Jul. 1966 108 p refs

(Contract DA-49-092-ARO-111)

(AD-635944) CFSTI: HC $4.00/MF $0.75

Properties of the six stop consonants of English speech were studied with the aid of electronic gating circuitry and associated display equipment. The apparatus made possible transient-free blanking of an adjustable-duration section at adjustable location in an input test utterance recorded on a tape loop. Alternatively, a section of the utterance could be excised and heard in isolation from its context. Output gated speech was evaluated subjectively by listeners. Results provide information on the distribution in time of recognition clues to perception of the stop consonants, and on the dependence of this distribution upon such factors as clarity of enunciation. Bandwidth-compression experiments were also conducted, using a system to reconstruct speech from narrowband transmitted analogs of zero-crossing rate, amplitude-envelope, and pitch period. Results suggest that a combination of the three analogs is preferable to previous operation without pitch. Author (TAB)

N66-37070# Pacific Missile Range, Point Mugu, Calif.

USE OF TEFLON TO REDUCE CORROSIVE EFFECTS ON SHIPBOARD ANTENNAS

L. C. Read 14 Mar. 1966 36 p

(PMR-TM-66-1; AD-635858) CFSTI: HC $2.00/MF $0.50

A coating material containing Teflon was used to repaint shipboard antennas undergoing maintenance or rehabilitation. The purpose of the project was to eliminate or reduce the corrosive effects of stack effluent, a major cause of the corrosion which results in antenna deterioration and failure. The corrosion problems connected with shipboard antenna maintenance are analyzed and illustrated. Current antenna procedures are described and their costs analyzed in terms of repeated antenna rehabilitation and reliability. The results of the project using the coating material containing Teflon are described and illustrated together with an analysis of relative cost and reliability. Author (TAB)

N66-37146*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.

APOLLO INFRARED ACQUISITION AND TRACKING SYSTEM

H. L. Richard Washington, NASA, Oct. 1966 64 p refs

(NASA-TN-D-3362) CFSTI: HC $2.50/MF $0.75 CSCL 17E

Reentry heating of the Apollo vehicle will generate sufficient energy in the infrared band to permit acquisition and tracking at a range of 500 nautical miles from an aircraft flying at 35,000 ft. Cloud coverage between target and sensor could attenuate the signal received by an infrared tracking device, but recent findings show that cloud cover over the reentry area above 35,000 ft should be minimal. Clouds within search range could appear as a target on the operator's screen as well as stars, platform and optics radiation, aircraft appendages, and the Apollo Service Module. A study conducted to define boundary values for the maximum and minimum infrared radiation of the Apollo spacecraft indicates that spacecraft surface temperatures will be between 1000°K ablation and a 2500°K equilibrium temperature. With the minimum temperature, calculation of the total radiation at the optical aperture of the system gives a value of 4.9×10^{-12} watts/cm^2 at a range of 500 nautical miles. The calculated irradiation at the aperture and the sensitivity of a detector using available components would give a signal-to-noise ratio of 6.5. An infrared hemispherical scanner is feasible with existing optical systems and components. R.N.A.

N66-37148*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.

THE BIASING EFFECT OF RANDOM BIT ERRORS ON BINARY TELEMETRY DATA

Morton Pasternack Washington, NASA, Oct. 1966 12 p refs

(NASA-TN-D-3481) CFSTI: HC $1.00/MF $0.50 CSCL 09F

Random bit errors that occur in pulse code modulated (PCM) data during the various phases of the telemetry-data-processing system will not only add a component of mean square error to the experimental data, but will also bias them. This paper derives a formula for the bias and describes some of its characteristics. Author

N66-37153*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.

A STATISTICAL DATA COMPRESSION TECHNIQUE

James W. Snively, Jr. Washington, NASA, Oct. 1966 32 p refs

(NASA-TN-D-3616) CFSTI: HC $2.00/MF $0.50 CSCL 09F

Data contained in a histogram can be compressed by calculating and transmitting two quantities: The area of the histogram and the sum of the squares of each bar of the histogram. The paper presents a survey of what knowledge one has about the original histogram when given only these two quantities. A set of theorems is derived which indicates the magnitude limits of the individual bars of the histogram as a function of these two quantities. The technique results in a data compression factor of greater than 10 for certain scientific experiments where the only information required is the amplitude distribution of the individual histogram bars. Author

N66-37175# Sylvania Electric Products, Inc., Waltham, Mass. Applied Research Lab.

MAGNETIC DIRECTION DEPENDENCE OF VLF PHASE VELOCITY FOR THE FIRST TWO WAVEGUIDE MODES

Janis Galeus Jun. 1966 32 p refs

(Contract Nonr-3185(00))

(RR-504; AD-635939) CFSTI: HC $2.00/MF $0.50

The methods previously reported for the computation of the complex propagation constant for the dominant VLF waveguide mode (N=1) are extended to the second mode (N=2). A stratified cylindrical ionosphere model with axial magnetic field is used to determine the wave impedances needed in the subsequent iterative procedure which yields the modal propagation constants in the magnetic east to west (EW) and magnetic west to east (WE) directions. The predictions for phase velocity differences between modes N=1 and N=2 can account for the recently reported observations on the magnetic direction dependence of the distance D between interference minima of these modes propagating below the nighttime ionosphere. The individual height variations of the

components of the conductivity tensor should be considered, and ionosphere models of exponential height variation of conductivity are not adequate. The phase velocity difference between the two modes is less than one per cent, but it is smallest for EW propagation, so that the mode interference distance is 1000 to 2000 km greater for EW propagation than for WE propagation. Author (TAB)

N66-37189# Applied Physics Lab., Johns Hopkins Univ., Silver Spring, Md.

THE PHENOMENON OF GENERATION BY A CIRCULAR CYLINDER AND A SPHERE

A. M. Goncharenko and B. A. Sotskii 20 Jun. 1966 12 p refs Transl. into ENGLISH from Dokl. Akad. Nauk Belorussk. SSR (Moscow), v. 8, no. 12, 1964 p 784–787
(Contract NOw-62-0604-c)
(TG-230-T477; TT-66-61805; AD-635878) CFSTI: HC $1.00/MF $0.50

The problem of stimulated electromagnetic wave emission from a circular cylinder and a sphere is investigated theoretically on the basis of Maxwell's equations. In particular, it is shown that radiation similar to that of a sphere should occur on the lateral surface of a cylinder. This radiation, since it is not used, is a source of additional energy losses and reduces the efficiency of a laser. These losses should not appear in a gaseous laser nor when the lateral wall of a cylinder with a refractive index greater than in the active medium is enclosed in a dielectric. Transverse-electric modes are considered; all the computations are the same for transverse–magnetic modes. Author (TAB)

N66-37225*# Northeastern Univ., Boston, Mass.

RADIATION AND CURRENT PROPERTIES OF THE RESISTIVELY LOADED TRAVELING WAVE V-ANTENNA

Seldon S. Sandler 15 Jul. 1966 106 p refs *Its* Sci. Rept.-3
(Grant NsG-355)
(NASA-CR-78148) CFSTI: HC $4.00/MF $0.75 CSCL 09F

The traveling wave V-antenna consists of two resistively loaded sections placed in a V configuration and fed at the apex. If the value of load resistance is properly chosen, only the outward going traveling wave is present on the section between the driving point and the termination. The antenna operates best when the driving frequency is such that the resistance is a quarter wavelength from the end of the antenna. In order to calculate the equivalent temperature of the antenna the driving point impedance is required. This impedance is determined based on a physically reasonable model of an infinite traveling wave V-antenna. Numerical results are presented for a wide variety of antenna diameters and apex angles. Detailed calculations are also given for the RAE satellite antenna of this assumption for normally used apex angles (i.e., greater than 20°). The results for optimum load resistances are presented for the case when the traveling wave section is antiresonant. A general discussion of the relevant parameters needed to describe the antenna is given, along with a summary of the radiation properties. The Fortran programs used in the theoretical calculations are included. C.T.C.

N66-37227# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.

CERTAIN QUESTIONS OF THE THEORY OF DETECTION OF SINGLE PULSES

V. F. Nesteruk and N. N. Porfir'yeva 14 Jan. 1966 18 p refs Transl. into ENGLISH from Tr. Leningr. Korablestroitel'nogo Inst. Sudostroyeniye i Sudovoye Mashinostr. (Leningrad), no. 36, 1962 p 121–133
(FTD-MT-65-62; TT-66-61799; AD-635852) CFSTI: HC $1.00/MF $0.50

Four types of signal shapes are considered: (1) signals known exactly in interval of time T (simple-synchronous detection); (2) signals, whose moment of appearance is known exactly, but their shape is random (complex synchronous detection); (3) signals with random shape and moment of appearance in interval T (complex asynchronous detection); (4) signals of known shape and random moment of appearance (simple asynchronous detection). Author

N66-37270*# Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena.

TRACKING AND DATA ACQUISITION FOR RANGER MISSIONS VI–IX

N. A. Renzetti 15 Sep. 1966 275 p refs
(Contract NAS7-100)
(NASA-CR-78163; JPL-TM-33-275) CFSTI: HC $3.75/MF $1.50 CSCL 09F

The technical activities of the Deep Space Network (DSN) in support of the Ranger VI to IX missions are summarized. The five Ranger missions are discussed in relation to flight plan, mission synopsis, Deep Space Instrumentation (SIF) configuration and preparation for the mission, tracking operations, and performance evaluation. The participation of non-DSIF agencies such as Space Flight Operations Facility, Manned Space Flight Network, and the Air Force Eastern Test Range is considered. Details are given on the tracking and data acquisition and associated support functions, including communication, transmission, processing and data reduction. Preflight mission support is documented in the form of operational readiness tests at the individual DSIF stations and the non-DSIF participating agencies. Tracking operations summaries for each DSIF station are presented with emphasis on critical phases of flight control. Edited station logs and organization charts for each mission are included. M.G.J.

N66-37290*# Electro-Mechanical Research, Inc., Sarasota, Fla.

MANNED SPACECRAFT ADVANCED DIGITAL TELEVISION COMPRESSION STUDY. VOLUME I: TEXT Final Report

26 Apr. 1965 287 p refs
(Contract NAS9-3429)
(NASA-CR-65508) CFSTI: HC $3.75/MF $1.50 CSCL 17I

The results of an investigation, combining theoretical and experimental approaches, into advanced digital television techniques having potential application to future manned spacecraft missions are presented. Summarized data from the various study tasks are provided. These tasks included compression techniques studies, digital communication channel analysis, digital color television investigations, and digital TV equipment and system capability improvement studies. From the standpoint of compression potential, linear approximation was found to be superior to the other coding techniques considered. A four bits per cycle modulation–demodulation system was determined feasible. It is reported that a modified, analog SECAM color television system is the best choice for live spacecraft television transmission. Additionally it was determined that current operating and adjustment procedures allow optimum digital operation of the WX 4911 electrostatic vidicon. Program conclusions and recommendations are given, and the detailed results of the study tasks are appended. H.S.W.

N66-37291*# Electro-Mechanical Research, Inc., Sarasota, Fla.
MANNED SPACECRAFT ADVANCED DIGITAL TELEVISION COMPRESSION STUDY. VOLUME 2: PHOTOGRAPHS Final Report
26 Apr. 1965 38 p
(Contract NAS9-3429)
(NASA-CR-65507) CFSTI: HC $2.00/MF $0.50 CSCL 17B

Pictorial results obtained in several of the supporting experimental area of the advanced digital television compression study are presented. The photographs were taken from the display unit of the experimental system. H.S.W.

N66-37322*# Massachusetts Inst. of Tech., Cambridge. Center for Space Research.
PROCESSING SOLAR PROBE TRACKING DATA (SUNBLAZER)
Harry T. Doerer and Robert W. Langley (M.S. Thesis) Aug. 1966 117 p refs
(Contract NASr-249)
(NASA-CR-78160; CSR-T-66-5) CFSTI: HC $4.00/MF $1.00 CSCL 09F

The Sunblazer is a small solar probe that must be tracked by measuring azimuth, elevation, and range rate at one station on the Earth's surface. The geometrical aspects of relating Earth station coordinates to an inertial coordinate system are examined. A Kalman filter is developed to provide a recursive maximum-likelihood estimate of the deviation of the probe's true state from a nominal state. The filter is incorporated in the flow chart of a complete data processing program. The diagonal elements of the state deviation error covariance matrix at conjunction are computed for varying qualities of range rate data and are shown to coincide with the results of a similar investigation. In addition, the possibility of optimally scheduling the measurements is discussed. Author

N66-37393# Navy Underwater Sound Lab., New London, Conn.
THE HORIZONTAL MONOPOLE WITH FEED POINT AT GROUND LEVEL OVER A FINITELY CONDUCTING GROUND
Dennis E. Fessenden 24 Jun. 1966 102 p refs
(USL-758; AD-636045) CFSTI: HC $4.00/MF $0.75

The horizontal dipole or monopole at or near the surface of the ground has received extensive treatment in recent years; however, one of the disadvantages of this type of antenna is its bidirectional antenna pattern. One way of overcoming this disadvantage is to raise the monopole slightly above ground while keeping the feed point at ground level. Expressions are developed for the input impedance, electric field vectors, patterns, and power gain of this type of antenna based on the assumptions: (1) the displacement currents in the homogeneous ground are negligible compared to the conduction currents; (2) the horizontal portion of the antenna is much longer than the vertical portion (the practical case for low profile antennas); and (3) the product of the vertical height and free-space phase constant is less than 0.1. A comparison of experimental and theoretical data indicates that the actual antenna is electrically longer than predicted by theory. This may possibly be taken into account by increasing the physical length of the antenna by an empirical correction factor of 4 to 6 percent in the theoretical calculations.
Author (TAB)

N66-37395# Institute for Defense Analyses, Arlington, Va. Research and Engineering Support Div.
TELECONFERENCING: EFFECTS OF COMMUNICATION MEDIUM, NETWORK, AND DISTRIBUTION OF RESOURCES
W. Richard Kite and Paul C. Vitz Mar. 1966 31 p *its* Study S-233
(Contract ARPA SD-50)
(IDA/HQ-66-4664; AD-636143) CFSTI: HC $2.00/MF $0.50

This study is a description of the series of experiments on teleconferencing conducted at IDA beginning in 1963 and at Stanford University in 1964–65. It focuses on the definition of problems that might be associated with the use of various media for teleconferencing. Author (TAB)

N66-37421# Texas Univ., Austin. Electrical Engineering Research Lab.
ELECTROMAGNETIC SCATTERING CHARACTERISTICS OF A METEOROLOGICAL RADAR ANGLE MODEL BY METHODS OF PHYSICAL OPTICS
W. N. Kocurek and A. H. La Grone 1 Jun. 1966 82 p refs
(Grant NSF GP-2596)
(P-6)

Coherent-dot radar angels are reflectors of radar energy which exist in the lower troposphere but remain invisible to the aided eye. The Atlas model studied is representative of the gap of an atmospheric thermal or pre-cloud. The source of the radar return is thought to be a very sharp refractive index gradient, smooth to a fraction of a wavelength, existing at the lower face of the cap. The cap has the shape of a truncated paraboloid (opening downward), and the principal radii of curvature at the apex vary from 0.2 to 0.5 times the scatterer altitude. A physical optics study of the model using the Kirchoff–Huygens principle is made, and approximate, general, bistatic cross-sections of the model are determined. Cross-sections are developed for both the Fraunhofer and the Fresnel diffraction regions. For each region, linear incident-energy polarization both in and perpendicular to the plane of incidence is considered. In all but the simplest special cases, evaluation of the resulting relations for the cross-section requires some numerical integration. Author

N66-37422# Library of Congress, Washington, D. C. Aerospace Technology Div.
COMMUNICATIONS NETWORKS. PART I: REVIEW OF SOVIET LITERATURE Surveys of Foreign Scientific and Technical Literature
Wladimir Podpaly and Wallace Cretan 6 Jul. 1966 84 p refs Compilation of Abstracts
(ATD-66-86)

This compilation of abstracts is based on Soviet open sources published mostly in 1965, and includes communications equipment and communications facilities and their location. These abstracts include the following information: antenna matching device, circuit diagrams of various types of equipment, communication cables, block diagrams of facsimile equipment, switching equipment, data transmission on telegraph channels, train radio communication, three-channel carrier system for open-wire lines, railroad computer center, high-speed data transmission system on telephone lines. A review of the development of Soviet facsimile equipment is included. Author

N66-37495# Aktiebolaget Atomenergi, Stockholm (Sweden).
OPTIMAL LINEAR FILTERS FOR PULSE HEIGHT MEASUREMENTS IN THE PRESENCE OF NOISE
K. Nygaard Jul. 1966 19 p refs
(AE-235) CFSTI: HC $1.00/MF $0.50

For measurements of nuclear pulse height spectra a linear filter is used between the pulse amplifier and the pulse height recorder so as to improve the signal/noise ratio. The problem of finding the optimal filter is investigated with emphasis on technical realizability. The maximum available

signal/noise ratio is theoretically calculated on the basis of all the information which can be found in the output of the pulse amplifier, and on an assumed a priori knowledge of the pulse time of arrival. It is then shown that the maximum available signal/noise ratio can be obtained with practical measurements without any a priori knowledge of pulse time of arrival, and a general description of the optimal linear filter is given. The solution is unique, technically realizable, and based solely on data (noise power spectrum and pulse shape) which can be measured at the output terminals of the pulse amplifier used. Author (ESRO)

N66-37532# General Technical Services, Inc., Yeadon, Pa.
INFORMATION SCIENCE: OUTLINE, ASSESSMENT, INTERDISCIPLINARY DISCUSSION
Arthur S. Iberall Arlington, Va., Army Res. Office, Jun. 1966 91 p refs
(Contract DA-49-092-ARO-114)
(AD-635809) CFSTI: HC $3.00/MF $0.75

This report provides an assessment and introduction to the interdisciplinary literature of three aspects of Information Science, in annotated bibliography form. These are: communication networks; human information processes, principally language and information retrieval; and the large cybernetic systems such as the human brain and central nervous system. Author (TAB)

N66-37533# Ballistic Research Labs., Aberdeen Proving Ground, Md.
140 GHZ MILLIMETRIC BISTATIC CONTINUOUS WAVE MEASUREMENTS RADAR
J. E. Kammerer and K. A. Richer Jan. 1966 46 p refs
(BRL-MR-1730; AD-484693)

A laboratory model continuous wave bistatic radar operating at heretofore unmeasured millimetric wavelengths is being used in a field measurements program to explore the effects of the near-earth environment. Operational at a radio frequency of 140 GHz (2.1 mm wavelength), the radar frequency generating and receiving equipment is described and measured sensitivities are listed. The radar is adaptable to field measurements programs that cover a range of operational frequencies extending into the submillimeter wavelength region of the spectrum. Author (TAB)

N66-37568*# Illinois Univ., Urbana. Electrical Engineering Research Lab.
PROPAGATION OF SPHERICAL WAVES THROUGH AN INHOMOGENEOUS MEDIUM CONTAINING ANISOTROPIC IRREGULARITIES
Chao-Han Liu 15 Sep. 1966 36 p refs
(Grant NsG-24-59)
(NASA-CR-78360) CFSTI: HC $2.00/MF $0.50 CSCL 20N

Amplitude and phase fluctuations of a spherical wave and amplitude and phase correlation functions of two spherical waves propagating in an inhomogeneous medium containing anisotropic irregularities are calculated. With ionospheric propagation application in mind (e.g., spaced-receiver experiments), the medium is assumed to be characterized by a dielectric permittivity which consists of two parts: an average permittivity which varies as a function of height and a part which is a random function of position. For radio frequency waves and weakly random irregularities, methods of WKB approximation and small perturbation are used to derive general expressions for fluctuations and correlations. Calculations are carried out for a specific case where the background medium is a parabolic plasma layer with small anisotropic irregularities imbedded in it. Results are compared with the expressions derived for a homogeneous medium containing anisotropic irregularities. Author

N66-37570*# Illinois Univ., Urbana. Dept. of Electrical Engineering.
THE RADIATION RESISTANCE OF A DIPOLE IN A UNIAXIAL MEDIUM Scientific Report No. 7
D. K. Waineo and R. Mittra Oct. 1966 54 p refs *Its* Antenna Lab. Rept.-66-14
(Grant NsG-395)
(NASA-CR-78359) CFSTI: HC $3.00/MF $0.50 CSCL 09F

The fields of a dipole antenna immersed in a lossy uniaxial medium are determined. A quantity named "effective resistance" is defined in terms of the surface integral of the Poynting vector on a sphere centered at the antenna, and computations of this are presented as plots of the effective resistance against the radius of the sphere for various antenna lengths and medium losses. At frequencies below the plasma frequency, the effective resistance is found to be inversely proportional to antenna length near the antenna but proportional to the square of the length at large distances. These results are used to provide an explanation for the paradox of increasing radiation resistance with decreasing antenna length which occurs in lossless hyperbolic anisotropic plasmas. Author

N66-37571*# Harvard Univ., Cambridge, Mass. Gordon McKay Lab.
THEORETICAL AND EXPERIMENTAL INVESTIGATIONS OF ANTENNAS AND WAVES IN PLASMA Semiannual Status Report, Mar. 1–Aug. 31, 1966
Ronald W. P. King 1 Sep. 1966 4 p
(Grant NGR-22-007-056)
(NASA-CR-78351) CFSTI: HC $1.00/MF $0.50 CSCL 09F

Various studies dealing with antennas and waves in plasma are reported. Experimental and theoretical investigations include: measuring the impedance and current distribution of finite length dipole antennas surrounded by a plasma sheath, studying acoustic interactions in plasmas, measuring the properties of a transmission line immersed in a plasma, finding the radiation resistance of an antenna immersed in a cold magneto-plasma, and writing a computer program to give the Fourier coefficients that describe the current distribution on a dipole antenna immersed in a warm isotropic plasma. S.P.

08 COMPUTERS

Includes computer operation and programming; and data processing. For basic research see: 19 Mathematics.

N66-36565# Atomic Energy of Canada, Ltd., Chalk River (Ontario).
TD-3: A G-20 COMPUTER PROGRAM
J. M. Kennedy and F. E. Bain Mar. 1966 44 p
(AECL-2591) Available from Atomic Energy of Canada, Ltd., Chalk River: $1.00

TD-3 is a computer program for solving the time-independent heat conduction equation in three dimensions. The solution is obtained in a composite volume of different conducting materials. From the user's point of view the main feature of the program is the simplicity of preparing input data. TD-3 is written in APEX-IV, an ALGOL-like algebraic language. Author

N66-36949# Illinois Univ., Urbana. Dept. of Computer Science.
COMPUTER SYSTEMS RESEARCH Annual Report, Sep. 1, 1965–Aug. 31, 1966
26 May 1966 62 p refs
(Contract AT(11-1)-1489)
(TID-23020) CFSTI: HC $3.00/MF $0.75

The study and implementation of the central computer software and remote console designs for special and general purpose time-sharing are described. During the year, the operational status of the ILLIAC II software system has changed from a Batch processing system through a Temporary Time-sharing System to a Provisional Time-Sharing System using three consoles for general purpose time-sharing simultaneously with regular batch processing. An initial version of the final Time-Sharing System is expected to be operational in the fall. Hardware was constructed to interface Teletype consoles to the main frame of the ILLIAC for the Provisional System, and a channel was constructed to interface the PDP-7 Satellite Computer to the ILLIAC. Revisions are being made to the batch processing translators FORTRAN and NICAP for interactive use in the time-sharing system. A number of special purpose time-shared programs were written to handle desk calculator work, interactive debugging of FORTRAN programs and automatic interactive numerical integration of ordinary differential equations. Work has begun on a study of the types of programming languages that should be used at a remote console with graphite capability and some preliminary work was done on the type of remote console that can be constructed for, say, $10,000 in 4 year's time, and what sort of language should be used to communicate between such a console and the main machine. Pattern processing and memory research is described. NSA

N66-36974# Atomic Energy Commission Research Establishment, Riso (Denmark).
QUARTERLY REPORT OF THE ELECTRONICS DEPARTMENT FOR THE PERIOD OCTOBER 1–DECEMBER 31, 1965 [BERETNING OM ARBEJDET I ELEKTRONIKAFDELINGEN I TIDEN 1 OKTOBER TIL 31 DECEMBER 1965]
Mar. 1966 18 p refs In DANISH
(RISO-M-385; R-2-66)

Work is reported on the PDP-8 computer system, apparatus for testing of digital computers, numerical studies on instrumentation, effects of dial instruments, and coupling of PDP-8 to analog computers. NSA

N66-36978# Oak Ridge National Lab., Tenn.
CDC-160A PROGRAMS FOR PROCESSING DATA FROM A NEUTRON TIME-OF-FLIGHT CROSS-SECTION EXPERIMENT
W. E. Kinney and J. A. Biggerstaff Apr. 1966 21 p refs
(Contract W-7405-ENG-26)
(ORNL-TM-1208) CFSTI: HC $1.00/MF $0.50

Codes were written for processing the data from experiments which measure neutron elastic- and inelastic-scattering cross sections by the time-of-flight technique. The data are accumulated in an ND-160 4096-channel pulse-height analyzer and are extracted from it by means of punched paper tape or sent directly to a CDC-160A computer over a data-link cable. The codes enable the data to be printed, the background to be normalized and subtracted, the walk in the circuitry to be corrected, and the corrected results to be printed. Author (NSA)

N66-37023# Stanford Univ., Calif. Linear Accelerator Center.
CHARACTERISTICS OF SMALL COMPUTER SYSTEMS FOR ON-LINE APPLICATIONS
Richard M. Brown May 1966 13 p ref Presented at the AEC-Argonne Natl. Lab. Conf. on the Use of Computers in Analysis of Exptl. Data and Control of Nucl. Facilities, Argonne, Ill., 4–6 May 1966 Sponsored by AEC
(Contract AT(04-3)-400)
(SLAC-PUB-191; Conf-660527-3) CFSTI: HC $1.00/MF $0.50

A summary of the characteristics of 31 domestic computers relevant to on-line applications is presented. Some of the problems specific to on-line use are discussed and the alternatives available in different models are described. For the survey, a small computer is taken as any which might be dedicated to on-line operation, excluding time-sharing systems. Author (NSA)

N66-37057# RAND Corp., Santa Monica, Calif.
THE TABULAR PARSER: A PARSING PROGRAM FOR PHRASE STRUCTURE AND DEPENDENCY
Martin Kay Jul. 1966 55 p refs
(Contract AF 49(638)-1700; Proj. RAND)
(RM-4933-PR; AD-635934) CFSTI: HC $3.00/MF $0.50

A comparison of phrase structure and dependency grammars and description of a computer program for parsing sentences concurrently by both systems with cross references. A simple, concise notation system, rule tables, and directions for punched-card input are given for use with a Fortran IV program with MAP subroutines. The program itself is the same without regard to language, rules, or directory entries input, and is based on a morsel strategy, described in algol logic. Author (TAB)

N66-37094# RAND Corp., Santa Monica, Calif.
OCTAL FRACTION CONVERSION TABLES
Paula M. Oldfather Jul. 1966 18 p
(Contract AF 49(638)-1700; Proj. RAND)
(RM-5051-PR; AD-636098) CFSTI: HC $1.00/MF $0.50

This memorandum presents a set of three tables for the rapid conversion of real numbers from the floating point octal representation used internally by digital computers to the decimal representation employed by human beings. In addition to the standard octal-to-decimal conversion, octal fractions are further converted to decimal hours and hours and minutes. Thus, while the memorandum should prove useful to anyone who works closely with digital computers and is required to make such conversions, it should be especially valuable to simulation programmers. Author (TAB)

N66-37095# Illinois Univ., Urbana. Coordinated Science Lab.
ON THE DESIGN AND TESTING OF SELF-DIAGNOSABLE COMPUTERS
Ralph A. Marlett Jul. 1966 72 p refs
(Contract DA-28-043-AMC-00073(E); Grant NSF GK-38)
(R-293; AD-636274) CFSTI: HC $3.00/MF $0.75

A new approach for deriving self-diagnosis programs for digital computers is investigated. The derivation procedure is based on only a micro-order description of the computer to be tested. The detailed logic information is not needed. This approach is made possible by standardizing computer realization techniques by means of a set of design principles. The thesis describes such a set of design principles which guarantees the existence of a relationship between the behavior of a computer under a large number of failures and alterations of the micro-order specification for that computer. The micro-order alterations are then used to characterize a computer under failure for every machine instruction so that test programs can be written which check for over 93% of all failures. Such programs check for symptoms of failure rather than the actual component which caused the failure since the logic is not necessarily assumed to be known. This procedure can be programmed so that diagnostic programs can be generated by a computer. An experiment is also described which substantiates the theoretical findings. Author (TAB)

N66-37185# Computer Command and Control Co., Washington, D. C.

A DATA STRUCTURE FOR DIRECTED GRAPHS IN MAN-MACHINE PROCESSING Annual Report

William C. Mann and Paul A. Jensen 20 Jun. 1966 76 p refs

(Contract Nonr-4815(00))

(Rept.-77-106-1; AD-636251) CFSTI: HC $3.00/MF $0.75

This report describes research in information processing intended for application to man–machine communication processes. In order to allow a computer user to represent some problems more easily, we would like to let him name and define relations between information entities with which he deals, and then manipulate a large number of such relations stored by the computer. A set of statements on the relative desirability of various conditions is an example of a set of relations which the user might want to store and manipulate. The problem is that available representations for such sets of relations tend to be unwieldy and may require a great deal of processing for large numbers of relations. In order to make such a capability available, compact and easily-manipulated internal computer representations for large numbers of the various kinds of two-entity relations must be found. This report describes such a development for one basic logical form of relation, the transitive, anticommutative relation exemplified by 'precedes', 'includes', 'is greater than', and similar phrases. The report describes a method for storing directed graphs (of transitive anticommutative relations) in a list-structured computer memory. There are three important features of this representation method: a method of dividing a graph into a number of strata based on the lengths of paths in the graph, a recursive decomposition technique which produces successively less complex versions of the graph, and a recursive search technique which utilizes the stratification and decomposition to extract information from the graph with a limited amount of processing. TAB

N66-37280*# Honeywell, Inc., Minneapolis, Minn. Systems and Research Div.

SPACEBORNE MEMORY ORGANIZATION Interim Report

D. C. Gunderson, C. W. Hastings, and G. J. Prom 15 Dec. 1965 121 p refs

(Contract NAS12-38)

(NASA-CR-78278; Honeywell-12017FRI) CFSTI: HC $3.00/MF $1.00

In evaluating the application of associative memories to future planetary exploration with unmanned vehicles (1975 to 1985), on-board computational requirements were defined in terms of a set of computation descriptors. Although a large portion of the computation had to be described in terms of more basic descriptors than intended, it was generally concluded that the most frequently used computation descriptor was the sum of products. Data compression is identified as one of the most severe requirements on the on-board computer system. Associative memory organizational approaches were surveyed, and each approach is described in terms of a set of computation descriptors, of its searching and processing capabilities, and of the devices suitable for its mechanization. These approaches included minimum associative memory, and associative memory with bit slice writing, with all-parallel equality search, with ternary output from cell, and with intercommunicating cells. Details are given on the use of an associative memory for incremental computation. Some considerations on organizing an ultra-reliable associative memory are briefly discussed. M.G.J.

N66-37334# Illinois Univ., Urbana. Dept. of Computer Science.

[DEVELOPMENTS IN COMPUTER AND COMPUTER PROGRAM RESEARCH] Quarterly Technical Progress Report, Oct.-Dec. 1965

[1965] 181 p refs

(Contracts AT(11-1)-1018; Nonr-1834(15))

(COO-1018-1076; COO-1469-0017) CFSTI: HC $5.00/MF $1.00

Further research developments are reported for each of the following areas: circuit program, hardware systems, time-sharing systems, ILLIAC III, numerical methods—computer arithmetic and artificial languages, ILLIAC II service and uses, and other associated research areas. NSA

N66-37448# Aberdeen Proving Ground, Md. Ballistic Research Lab.

A FORTRAN PROGRAM FOR GRID CALIBRATION

A. Roberta Wooten Apr. 1966 88 p Add. to BRL Memo. Rept.-1600

(BRL-MR-1742; BRL-MR-1600; AD-636847) CFSTI: HC $3.00/MF $0.75

This report is an addendum to 'A Forast Program for Stereocomparator Grid Calibration and Comparator Calibration' BRL Memorandum Report No. 1600, by A. Roberta Wooten. The grid calibration phase of the above report is programmed in Fortran language to make the program accessible to agencies using Fortran language on commercial electronic computers. Author (TAB)

N66-37473# Aktiebolaget Atomenergi, Stockholm (Sweden).

DETEC, A SUBPROGRAM FOR SIMULATION OF THE FAST-NEUTRON DETECTION PROCESS IN A HYDROCARBONOUS PLASTIC SCINTILLATOR

B. Gustafsson and O. Aspelund Jul. 1966 27 p refs

(AE-236) CFSTI: HC $2.00/MF $0.50

A description is given of the subprogram Detec, which for energies below 5 MeV simulates the detection process of a fast-neutron within a large cylindrical plastic scintillator. Detec has been coded in Fortran IV, and consists of a subroutine and a block-data subprogram. The latter is in its present form adapted to the dimensions 5 cm diam. by 8 cm of the scintillating materials NE102 and NE102A. The character of Detec as a subprogram is manifested through the requirement of a main routine for generation of the following input parameters (referred to the detector surface): fast neutron position, direction, energy, entrance time, and input weight. When these are provided, the virtues of Detec are recording of the detected weight and the time elapsed prior to the detection event. The merits of Detec are finally demonstrated in two typical applications. Author (ESRO)

N66-37551# Department of National Defence, Ottawa (Ontario). Operational Research Div.

COMPUTERS AND DEFENCE

R. J. Sutherland Jul. 1966 29 p *Its* Informal Paper No. 66P17 (ORD-66/P17) CFSTI: HC $2.00/MF $0.50

A discussion is given of the complex problems of social policy which are posed by electronic data processing and automation, some of the applications of computers and EDP to defense activities are described, and various technological innovations in general are mentioned. Emphasis is placed on management and strategy, and it is shown how EDP has affected the concepts and techniques of defense in these areas. It is suggested that the political and social effects of technological innovation including EDP are more complicated and more ambiguous than is often thought. C.T.C.

09 ELECTRONIC EQUIPMENT

Includes electronic test equipment and maintainability; component parts, e.g., electron tubes, tunnel diodes, transistors; integrated circuitry; microminiaturization. For basic research see: 10 Electronics. For related information see also: 07 Communications and 21 Navigation.

N66-36682# Weapons Research Establishment, Salisbury (Australia).

ELECTRICAL DESIGN REQUIREMENTS FOR HAZARDOUS CIRCUITS IN GROUND SYSTEMS

Aug. 1965 23 p refs *Its* Specification WRE-233, Issue 2 CFSTI: HC $1.00/MF $0.50

This specification outlines the requirements to bet met in the cesign of hazardous circuits, which are those electrical and/or electronic sections of hazardous systems by means of which explosive, pyrotechnic, chemical, gaseous or high pressure devices are electrically controlled either directly or indirectly. It is expected that equipment designers will acquaint themselves fully with the principles laid down in this specification and use them when designing any electrical or electronic ground support equipment which is required to be installed by Woomera and become part of the hazardous circuit system of the Range Network. Author

N66-36682# Joint Publications Research Service, Washington, D. C.

OPERATION OF THYRISTORS UNDER INDUCTIVE LOAD IN DIGITAL DEVICES

V. G. Mashlykin *In its* 22d All-Union Sci. Session Devoted to Radio Day. Sect. on Telemech. 18 Aug. 1966 p 135–143 ref (See N66-36666 22-07) CFSTI: $5.00

Characteristics of thyristors are described, and their operation under varying active inductive loads is discussed. Time dependence of the current flowing in the inductive branch of the circuit after closure of the key, which corresponds to switching on the thyristor, is considered; and formulas are given for finding both the forced and free components which make up the full current. It is concluded that with appropriate correlation of ratings of the reactive elements, the parallel circuit used as the load is equivalent to the active resistance in the anode circuit of the thyristor. In the event that the thyristor's load is an element with considerable inductance, connection of the element to the anode circuit permits the use of control pulses of limited length and simplifies circuitry design. M.W.R.

N66-36739# Joint Publications Research Service, Washington, D. C.

THE MUTUAL SYNCHRONIZATION OF REFLECTING KLYSTRONS WITH LARGE SIGNALS BETWEEN THE CAVITIES

D. M. Petrov and A. P. Pitelin *In its* 22d All-Union Sci. Session Devoted to Radio Day. Sect. on Electron. 19 Aug. 1966 p 30–35 refs (See N66-36537 22-10) CFSTI: $4.00

The stationary conditions of a system employing several mutually synchronized klystrons with large signals between the resonators is regarded as a single klystron with several electron streams. Preliminary study of two klystrons in a five-cavity system confirms the possibility of mechanical tuning by an external resonator as well as the reservation of a single-frequency condition during operation. Attention is given to a self-oscillating system with a number of reflecting klystrons; and equations are given for determining the fundamental frequencies of the system, amplitudes of the potential on the gaps of the klystrons, and the frequency with respect to the electronics of the klystron. In discussing the mutual synchronization of two reflecting klystrons connected through a cavity, the various equations are also given. It is noted that if the connections between the cavities in klystron systems are not identical, and there is a weaker connection to the intermediate connection, there is a greater effect on the frequency since the cavity serves as the stabilizer. M.W.R.

N66-36740# Joint Publications Research Service, Washington, D. C.

MODULATION SPECTRUM OF A TRAVELLING KLYSTRON RESULTING FROM FLUCTUATIONS OF THE POWER SOURCE

S. V. Korolev *In its* 22d All-Union Sci. Session Devoted to Radio Day. Sect. on Electron. 19 Aug. 1966 p 36–43 refs (See N66-36735 22-10) CFSTI: $4.00

Determination is made of the fluctuation range in the klystron power sources at given spectral density values of the output signal fluctuation. Statistical methodology is employed in computing increase of amplitude and phase of the output signal, expressions for which are obtained on the basis of the kinematic theory of the klystron with regard to the influence of the space charge. Equations are detailed for the determination of amplitude and phase modulation spectra. It is concluded that phase fluctuations resulting from accelerating voltage fluctuation depend almost entirely on the travel angle; therefore, it is necessary to increase the stability of the power source as the number of cavities at a given fluctuation level increases. The more powerful klystrons provide less phase fluctuation. M.W.R.

N66-36741# Joint Publications Research Service, Washington, D. C.

PARALLEL AND SERIES CONTOURS SHUNTING THE TRANSMISSION LINE

A. I. Karnaukh and D. M. Petrov *In its* 22d All-Union Sci. Session Devoted to Radio Day. Sect. on Electron. 19 Aug. 1966 p 44–52 ref (See N66-36735 22-10) CFSTI: $4.00

Frequency characteristics of resonant elements shunting transmission lines are discussed, and it is shown that parallel and series contour shunting sometimes exhibit similar characteristics. These shuntings can be used in the manufacturing of an ultrahigh frequency modulator with (1) separate AM and FM channels and (2) with linear relationship between the degree of modulation and the modulating voltage itself. The change in UHF current with chinging contour parameters is discussed, and formulas are given for computation of the degree of modulation. M.W.R.

N66-36742# Joint Publications Research Service, Washington, D. C.

RETUNING THE FREQUENCY OF A TRAVELLING GENERATOR WITH A MULTI-CONTOUR OSCILLATING SYSTEM

S. S. Zyrin, O. I. Karnaukh, and D. M. Petrov *In its* 22d All-Union Sci. Session Devoted to Radio Day. Sect. on Electron. 19 Aug. 1966 p 53–60 refs (See N66-36735 22-10) CFSTI: $4.00

Conditions of frequency stability are examined for a travelling generator with an arbitrary number of interconnected contours in the oscillating system. Various types of oscillation systems were studied, and equations were developed which relate all the basic parameters of the klystron as well as the travelling generator tuned in a system of connected contours. Stability of the operating frequency is determined for the oscillation system, and a formula is given for determination of the output power of the generator. M.W.R.

N66-36743# Joint Publications Research Service, Washington, D. C.

FREQUENCY CHARACTERISTICS AND COMPUTATION FEATURES OF THE MULTICAVITY KLYSTRON

S. S. Zyrin *In its* 22d All-Union Sci. Session Devoted to Radio Day. Sect. on Electron. 19 Aug. 1966 p 62–69 refs (See N66-36735 22-10) CFSTI: $4.00

Fundamental relations are presented for induced current in the output gap of the multicavity klystron, and the optimum frequency characteristics for such a klystron are considered. The Chebyshev and extremely flat characteristics are generally not optimum, and so formulas are given for computing the smooth or pulsation characteristics which correspond to optimum frequency. Nonlinearity of electron stream or cavity bunching is considered in order to avoid errors in obtaining the optimum conditions. M.W.R.

N66-36744# Joint Publications Research Service, Washington, D. C.

A STUDY OF ELECTRON VELOCITY DISTRIBUTION IN ELECTRON STREAMS FORMED BY A MAGNETIC FIELD

G. P. Egorov, Ia. I. Mestechkin, and L. V. Shubin *In its* 22d All-Union Sci. Session Devoted to Radio Day. Sect. of Electron. 19 Aug. 1966 p 70–75 refs (See N66-36735 22-10) CFSTI: $4.00

Spectra of the axial components of electron velocities are studied for the axisymmetric cylindrical electron beam formed by a longitudinal magnetic field. Electron velocity distribution curves indicate that the width of the obtained spectrum is greater than a Maxwell distribution, and that spectrum width decreases from the edge to the center of the beam. It is noted that the presence of maximum electron energy values from the anode potential may explain the presence of the tangential velocity component and the rotary motion of the electrons in the stream. M.W.R.

N66-36745# Joint Publications Research Service, Washington, D. C.

THE FOCUSING PROPERTIES OF THE FIELD OF A CYLINDRICAL CAPACITOR

A. N. Serebrianik and V. E. Kolker *In its* 22d All-Union Sci. Session Devoted to Radio Day. Sect. on Electron. 19 Aug. 1966 p 76–81 refs (See N66-36735 22-10) CFSTI: $4.00

The possibility of using the field of a cylindrical capacitor as an analyzer of angular distribution of charged particles is demonstrated. An axial cross section of the capacitor is shown, and the procedure is given for determining the trajectory parameters of the charged particles. Focusing of particles of varying velocities is discussed, and the relationship is graphed for the angle of entry at which focusing occurs and the dimensionless parameter. M.W.R.

N66-36746# Joint Publications Research Service, Washington, D. C.

THE TRAVELLING OF ELECTRON BEAMS THROUGH ELONGATED DIELECTRICAL CHANNELS

B. S. Dmitriev and Iu. D. Zharkhov *In its* 22d All-Union Sci. Session Devoted to Radio Day. Sect. on Electron. 19 Aug. 1966 p 82–85 refs (See N66-36735 22-10) CFSTI: $4.00

An ion focusing beam is used to investigate the ability of an unmodulated electron stream to pass through an elongated dielectric channel in the absence of a magnetic field. A variety of lamp models were employed and beam focusing was achieved in a hydrogen atmosphere. The coefficient of current travel was determined as the relationship of the currents of the (1) beam and (2) that approaching the last anode of the gun. The presence of a sufficiently wide region of pressure is shown in which there is 70 to 90% current passage to the collector; and this pressure region coincides with the region of optimum pressure for ionic focusing in conducting channels. Current at the collector increases along with accelerating voltage. Analysis indicates that an electron probe with an ion-focused beam can be used in the study of dispersion characteristics of braking structures. In order to determine impedance, however, a longitudinal magnetic field is used for the focusing beam. It is estimated that measurement errors for the coefficient of braking are about 1% and for the determination of impedance are between 3 and 4%. M.W.R.

N66-36747# Joint Publications Research Service, Washington, D. C.

COMPUTING ELECTRON PROCESSES NEAR THE DIELECTRIC IN THE VACUUM WAVEGUIDE

V. S. Gorovets and S. A. Rybak *In its* 22d All-Union Sci. Session Devoted to Radio Day. Sect. on Electron. 19 Aug. 1966 p 87–90 ref (See N66-36735 22-10) CFSTI: $4.00

The cross section of a vacuum waveguide is diagrammed, and determination is made of when its dielectric output has the shape of an elliptical cone. The only electrons involved in the avalanche build-up are those which have not settled on the walls of the dielectric output. An equation is given for determining the relative number, by cross section, of electrons considered favorable for avalanching; and other equations are given for the complete number of favorable electrons obtained by integrating along the height of the pyramid and for the critical field. M.W.R.

N66-36748# Joint Publications Research Service, Washington, D. C.

THE USE OF VARIABLE NONISOCHRONIZATION OF ELECTRON OSCILLATIONS FOR INCREASING THE EFFICIENCY OF PHASE-TIMED DEVICES

A. A. Kuraev and V. A. Stepukhovich *In its* 22d All-Union Sci. Session Devoted to Radio Day. Sect. on Electron. 19 Aug. 1966 p 91–99 ref (See N66-36735 22-10) CFSTI: $4.00

Cascade diagrams of a stropophotron are shown for which the bunching sections have nonisochronous electron oscillations and the discharge sections have isochronous oscillations. Consideration is given to the computation of the bunching sections which operate as a generator on the counter wave and have bilateral interclamp conformity. Nonlinear methods are used for determining the phase trajectories of the electrons in the bunching section. Equations are given for computing the electron travel and interaction in the output section. It is noted that maximum electron efficiency does not depend on the value of the amplification parameter, and it is concluded that the cascade strophotron described has a higher efficiency than the usual device. M.W.R.

N66-36805# Motorola, Inc., Phoenix, Ariz. Semiconductor Products Div.

PRODUCTION ENGINEERING MEASURE FOR A GERMANIUM PNP POWER TRANSISTOR Third Quarterly Progress Report, 15 Oct. 1965–14 Jan. 1966

Dan Sullivan and Paul Greer [1966] 44 p

(Contract DA-36-039-AMC-06161(E))

(U-18; AD-634826) CFSTI: HC $2.00/MF $0.50

A summary of the various investigations performed during the engineering phase of this contract and a discussion of preparations being made for the production phase is presented. Reliability test data and the results of Sp1882H evaluation studies have also been reported. Author (TAB)

N66-36910# Cutler-Hammer, Inc., Deer Park, N. Y. Airborne Instruments Lab. Div.

HF TUNABLE FILTERS Final Report

Irving Rubinstein, Robert L. Sleven, and David S. Levinson Griffiss AFB, N. Y., RADC, May 1966 84 p refs /ts Rept.-5594-1)
(Contract AF 30(602)-3558)
(RADC-TR-65-525; AD-636518) CFSTI: HC $3.00/MF $0.75

An investigation to advance the state of the art in narrow-band, high power 2 to 30 mc filters resulted in the realization of the elliptic-function filter response using transmission-line techniques. An analysis performed on this program showed the elliptic-function filter to be of substantially lower loss than conventional filters with monotonic attenuation band characteristics. Curves were prepared, with the aid of a computer, relating the midband insertion loss to the other response characteristics for the elliptic function filter. Design equations are presented for the transmission-line resonators and coupling structures in the elliptic-function filter. Several experimental filters using helical resonators were constructed and evaluated with the measured results showing close agreement with theory. The lower loss characteristic of the elliptic-function filter as compared with conventional filters was verified experimentally. Various tuning techniques were evaluated and a capacitively tuned experimental model covered a one-octave frequency band with only a small increase in loss due to tuning. Author (TAB)

N66-36930# Hamilton Standard Div., United Aircraft Corp., Windsor Locks, Conn.
ELECTRON BEAM TECHNIQUES FOR FABRICATION AND ASSEMBLY OF PARTS FOR ELECTRON TUBES Final Technical Report, 1 Jul. 1963–31 Mar. 1966
M. L. Kohn [1966] 369 p refs
(Contract DA-36-039-AMC-03625(E))
(EBR-187; AD-635870) CFSTI: HC $7.00/MF $1.75

An investigation was made of electron beam welding and drilling of materials in combinations and thicknesses which could normally be expected to be encountered in the manufacture of electron tubes. An analysis was made of two electron tubes, types 6544 and 6914, in order to choose joints to be electron beam welded. The efforst concerning the performance of preproduction and pilot line manufacture of these tubes are presented. TAB

N66-37049# Controls for Radiation, Inc., Cambridge, Mass.
CRITERIA FOR RADIATION INSENSITIVE INSULATORS
Sumner Mayburg Mar. 1966 13 p refs /ts Sci. Rept.-3
(Contract AF 19(628)-5214)
(AFCRL-66-273; AD-635605) CFSTI: HC $1.00/MF $0.50

A review of the accepted theory of radiation induced conductivity in insulators is presented. The recovery from a radiation pulse is analyzed in some detail and it is shown that in high resistivity materials the recovery time is limited by the normal conductivity of the insulator. Radiation insensitive insulators for use with solid state circuits should have resistivity in the range 1,000,000–10,000,000 ohms-cm, short carrier lifetime, and a minimum of trapping. In addition, ohmic contacts to the insulator to allow return of electrons driven off by the radiation must be made relatively easily. Semi-insulating gallium arsenide is suggested as a material fulfilling these criteria. Author (TAB)

N66-37052# Naval Radiological Defense Lab., San Francisco, Calif.
A TEMPERATURE COMPENSATING PREAMPLIFIER FOR DRIVING LONG COAXIAL LINES IN SCINTILLATION SPECTROSCOPY APPLICATIONS
Raymond A. Taylor and Raphael F. Ehat 11 Feb. 1966 38 p refs
(USNRDL-TR-1021; AD-635882) CFSTI: HC $2.00/MF $0.50

A temperature compensating transistorized, linear, unity gain preamplifier was designed and constructed for use as a coaxial cable line driver in a mobile gamma-ray scintillation spectrometry system. Its differential linearity was better than ±1% with input signals up to 3 volts when loaded with a terminated 93-ohm, 500-ft. coaxial cable. The use of a simple thermistor temperature conpensating network in the preamplifier of the detector-preamplifier package gave a system gain variation normalized at 25°C, as a function of temperature of less than +4% between 0°C and 25°C and less than −1% between 25°C and 50°C. Author (TAB)

N66-37063# Missouri Univ., Columbia.
PARAMETRIC AMPLIFIER
Carl W. Meyer (M.S. Thesis) Jun. 1966 56 p refs
(Contract AF 33(608)-1254)
(AD-635264) CFSTI: HC $3.00/MF $0.50

The use of computer techniques allows for the saving of valuable time in accurately designing a lumped circuit parametric amplifier. To show the development of such a computer program, the general theory of parametric amplifiers will be discussed with some equation development. The necessary conditions for parametric amplification is then outlined as the amplification criterion and a circuit containing basically four tuned tanks, a varactor, and load resistor, operating at one megacycle is shown to meet the parametric amplification criterion. From the knowledge of the necessary conditions for parametric amplification and the circuit equations developed, a complete computer program is developed to verify that a circuit and varactor will operate as an amplifier. The only information that needs to be included in the Fortran program is the desired operating signal and pump frequencies, the value of one component of the tank circuits and the characteristics of the varactor. If the conditions for parametric operation are satisfied, the computer will then determine the remaining circuit components, retaining only those which are realizable. The program also selects the best operating conditions from the many hundreds available. For each point selected, the computer will determine, among other things, the negative resistance and the component values of the impedance matching networks. Author (TAB)

N66-37079# Hughes Aircraft Co., Fullerton, Calif.
SURFACE EFFECTS OF RADIATION ON MICROELECTRONIC DEVICES, PART II Final Report, Nov. 1965–Apr. 15, 1966
Daniel Binder, Barbara M. Kuehne, and Donald A. Steele 15 Apr. 1966 80 p refs
(Contract N228(62479)68466)
(FR-66-17-186; USNRDL-TRC-44; AD-635583) CFSTI: HC $3.00/MF $0.75

Both intermediate and semipermanent effects of ionizing radiation were studied for three types of metal-oxide–silicon field effect transistors (MOSFET'S): the n-channel 2N4038 (enhancement), the p-channel 2N3638 (enhancement), and an n-channel silicon-on-sapphire thin film (depletion) device. Intermediate effects were studied by the observation of conductivity changes as a function of successive irradiations at various bias points. Both conductivity changes and changes in transconductance were observed in the study of semipermanent effects resulting from each irradiation. Author (TAB)

N66-37080# Michigan Univ., Ann Arbor. Electron Physics Lab.
SEMICONDUCTOR AND O-TYPE AMPLIFIER INVESTIGATIONS Quarterly Progress Report No. 6, 1 Dec. 1965–1 Mar. 1966

J. E. Rowe, et al Griffiss AFB, N. Y., RADC, Jun. 1966 50 p refs (Contract AF 30(602)-3569)
(RADC-TR-66-288; AD-636261) CFSTI: HC $2.00/MF $0.50

Electron-beam profiles are presented for nonlinear traveling-wave amplifiers in which the beam is focused with the Brillouin field and for devices with B B_{Br}. The Boltzmann–Vlasov equation is used to analyze the interaction between a beam and a slow-wave circuit, and a new normalization integrate in the sense of making it simpler to obtain convergent numerical solutions. Experimental results are presented on microperveance-one and microperveance-two guns and the design of the R-F beam analyzer equipment is discussed. The digital computer program for the analysis of magnetron injection guns has been improved with regard to stability of the solutions and accuracy. Experimental tests on the magnetron injection gun UHF TWA are carried out with emphasis on the optimization of the magnetic field distribution in the gun region in order to minimize the amplifier noise figure. A minimum noise figure of 15.3 db was obtained for a beam current of 410 ma and a beam power of approximately 1400 watts. Processes are described for applying ohmic ccntacts to n-type gallium arsenide with resistivities in the range of 0.22 to 10 ohm-cm. Principal effort has been on sintered contacts which are suitable for low duty-cycle operation of gun diodes. TAB

N66-37085# Marine Engineering Lab., Annapolis, Md.
THERMAL AGING STUDIES OF SOLENOID COIL INSULATION SYSTEMS
John A. Kimball and John F. Tobin Jun. 1966 32 p refs
(MEL-13/66; AD-636177) CFSTI: HC $2.00/MF $0.50

A procedure consisting of heat aging, vibration, humidification, and voltage stress has been developed for studying thermal aging characteristics of solenoid coil insulation systems. The procedure was applied to eight experimental epoxy-encapsulated solenoid coil insulation systems, and the thermal life of the eight systems was established. The procedure is recommended for general use in establishing the thermal life of coil insulation systems. Author (TAB)

N66-37110# Naval Ammunition Depot, Crane, Ind.
INFORMATION ON MICROELECTRONICS FOR NAVY EQUIPMENTS
1 Apr. 1966 87 p Prepared for Naval Air Develop. Center, Naval Appl. Sci. Lab. and Naval Electron. Lab. *Its* μ-Note No. 16
(Rept.-66-264; AD-635626) CFSTI: HC $3.00/MF $0.75

Contents: Post life test evaluation of Siliconix digital semiconductor integrated circuits; post life test evaluation of General Microelectronics digital semiconductor integrated circuits; post life test evaluation of Sylvania digital semiconductor integrated circuits; post life test evaluation of Fairchild digital semiconductor integrated circuits; microcircuit report on the AN/ARC-104(V); compilation of semiconductor integrated circuits evaluated to date. TAB

N66-37112# Grumman Aircraft Engineering Corp., Bethpage, N. Y. Research Dept.
PRESELECTING AND PRECONDITIONING OFF-THE-SHELF TRANSISTORS AND MICROCIRCUITS FOR RADIATION RELIABILITY
P. Grinoch and M. Rossi Jul. 1966 28 p refs
(RM-332; AD-485860)

Semipermanent and permanent radiation effects in silicon planar passivated transistors and monolithic silicon integrated circuits were evaluated by their induced damage to lattices and surfaces. Results showed that lattice damage became consequential after device exposure to either 10^{12} fast neutrons/cm^2, 10^7R of 1-Mev gamma or X-radiation, 10^{14} electrons/cm^2, or 10^{11} protons/cm^2. Similarly, surface damage became significant after exposure to either 10^5 R of gamma or X-radiation, 10^{13} electrons/cm^2, or 10^{12} protons/cm^2. Radiation vulnerability was intensified by the damage susceptibility of parameters such as β and I_{CBO}, so that the mean time-to-failure of a given transistor type in a given radiation field was characterized by an order-of-magnitude uncertainty. An example circuit was designed with degenerative feedback from more radiation resistant device types, such as Zehner diodes, Esaki diodes, and ferrite core devices, that tolerated β degradation by a factor of 12. G.G.

N66-37166# Navy Electronics Lab., San Diego, Calif.
CONVERTER COMPENDIUM
G. A. Brown ed, 1 Jul. 1966 721 p refs
(AD-636189) CFSTI: HC $10.20/MF $3.00

This compendium is based on in-house and commercial literature on the following types of converters: Shaft to digital (contact and noncontact), analog to digital, digital to analog, synchro to digital, digital to synchro, voice to digital. Major functional, electrical, and physical characteristics of the converters are described. TAB

N66-37171# Harry Diamond Labs., Washington, D. C.
SUPPRESSION OF MODULATION VOLTAGE ON THE RF TERMINALS OF A DIODE SWITCH
T. H. Mak and R. V. Garver Apr. 1966 23 p refs
(HDL-TR-1319; AD-635913) CFSTI: HC $1.00/MF $0.50

An analysis is made of a method for pulse-modulating a microwave signal so that the rise and fall times of the modulated pulse is on the order of 1 nsec. The components used are microwave switching diodes which have a switching time much less than 1 nsec and a filter circuit which helps to reduce switching transients emerging from signal and source terminals of the switch. Analysis relates the suppression of the switching transients to the number of filter elements and switching times. Author (TAB)

N66-37200# Radio Corp. of America, Somerville, N. J.
DEVELOPMENT OF A TRANSISTOR-VARACTOR DIODE CAPABLE OF 5 WATTS OUTPUT AT 2.3 GHZ Interim Technical Report, 1 Dec. 1965–28 Feb. 1966
P. L. Mc Geough and H. C. Lee [1966] 27 p
(Contract AF 33(615)-2486)
(ITR-3; AD-635831)

Significant improvement in the pattern definition and the registration between the various TA2790 photomasks was achieved in a second set of photomasks. Difficulties associated with the definition of the metal pattern have continued. However, modification of the metallizing pattern is expected to eliminate this problem and allow a valid evaluation of the device capability. Continued investigation of various diffusion cycles and epitaxial layer properties has shown an improvement in performance by the use of thin epitaxial layers in conjunction with both shallow base and P+ diffusion depths. Common-emitter amplifier measurements at 770 MHz have shown that flat-top stripline package to be superior to the TO-60 case. The advantages afforded by this package will be more significant during multiplier operation at increased output frequencies. Author (TAB)

N66-37202# Texas Instruments, Inc., Dallas. Semiconductor-Components Div.
PRODUCTION ENGINEERING MEASURE (PEM) FOR TRANSISTOR, PNP, SILICON, SWITCHING TYPE EL-2N(X-12) Fourth Quarterly Report, 25 Dec. 1965–25 Mar. 1966
Larry Lands Jun. 1966 43 p refs
(Contract DA-36-039-AMC-96160(E))
(TI-03-66-72; AD-635970) CFSTI: HC $2.00/MF $0.50

A small adjustment in epitaxial film resistivity was sufficient to raise BV_{CBO} and BV_{CEO} well within the PEM requirements for these parameters. As a result of the improved breakdown levels, the reverse leakage characteristics for the fourth engineering sample were an order of magnitude better than the third engineering group. The collector saturation voltage increased over the previous samples but 98 percent of the units were still below the 0.25 volt maximum. Delay and rise times did not meet the required minimum values of 3 and 4 nanoseconds, respectively. Typical values were T_D=3.4 ns and t_R=6.6 ns. Storage time averaged 8.8 ns and fall time was approximately 4.9 ns. Device current gain exerted a major influence on storage time. An attempt to improve current capability with a larger geometry was unsatisfactory due to switching speeds. The use of excess gold in the device structure appeared to produce lower storage time values, but also caused the overall current gain distribution to peak at a lower level. Molybdenum–gold proved to be unacceptable for a contact system on the small device area of the PEM transistor. An evaporation rate monitor system shows promise as a means of eliminating operator error during high volume metalization procedures. The system offers an automation capability as well as close control of the evaporation rate. Author (TAB)

N66-37211*# Massachusetts Inst. of Tech., Cambridge. Electronic Systems Lab.
GATED AMPLIFIERS FOR DATA PROCESSING IN SPACE
James Kerr Roberge Aug. 1966 240 p refs
(Grant NsG-234-61)
(NASA-CR-78128; ESL-R-279) CFSTI: HC $6.00/MF $1.50 CSCL 09A

The gated amplifier, a new circuit which incorporates integral electronic switching into the design of an operational amplifier, is described. Salient features of the gated amplifier are its low power consumption and its versatility for use in a variety of data-processing operations. These features make the gated-amplifier concept particularly attractive for use in space data-processing applications. A gated-amplifier circuit is designed and analyzed. Measured and predicted performance characteristics are compared. Representative data processing systems are designed with gated amplifiers and test results for two systems, a digital-to-analog converter and an analog multiplier-divider, are presented. In order to realize the full advantage of the gated-amplifier concept, certain ancillary circuits such as logic circuits and shunt switches are required. Representative designs are included. Author

N66-37221*# Autonetics, Downey, Calif.
PROCESS TECHNIQUES STUDY OF INTEGRATED CIRCUITS Quarterly Report No. 3
J. E. Meinhard 15 Feb. 1966 26 p refs
(Contract NAS12-4)
(NASA-CR-78253) CFSTI: HC $2.00/MF $0.50 CSCL 09A

Experimental activities have involved the investigation of package ambient compositions by mass spectrometry and gas chromatography to discover correlations with abnormal integrated circuit function. Low temperature reverse bias leakage associated with moisture traces has been observed with mesa transistors and the investigation is being continued with planar devices. A second area under study considers tool damage effects on silicon using X-ray diffraction and etching procedures. A third investigation explores the process origins of dielectric anomalies in passivation oxide to eliminate such defects by improved oxide growth techniques. Newly developed test methods are being used to reveal dielectric defects at any stage of wafer processing. Present evidence indicates that most dielectric defects are located at abrupt thickness transitions in the oxide. The investigation of the behavior of ionic impurities in otherwise sound oxide by radiochemical and isotopic techniques is being continued along previously established lines. R.N.A.

N66-37222*# Autonetics, Downey, Calif.
PROCESS TECHNIQUES STUDY OF INTEGRATED CIRCUITS Quarterly Report No. 4
J. E. Meinhard 15 May 1966 32 p refs
(Contract NAS12-4)
(NASA-CR-78254) CFSTI: HC $2.00/MF $0.50 CSCL 09A

Investigations continued on crystal damage arising from various tooling processes. Various types of crystal imperfections are described along with the methods for their detection. The most practical means of investigating crystal damage is a combination of techniques including either etching or decorating procedures, transmission electron microscopy, and the Schwuttke version of the Lang X-ray method. Controlled environment equipment was set up for analyzing polar gas effects on planar silicon devices and integrated circuits at low temperatures, and for polar and nonpolar gas effects at high temperatures. Results indicate that atmospheres in integrated circuit packages should be restricted to nonpolar gases such as hydrogen or helium. High temperature studies are focusing on the reversible effects of hydrogen on transistor beta's. The use of profilometers, interferometers, ellipsometers, and betascopes to measure the physical characteristics of thin films and surfaces at various processing stages of integrated circuits is discussed. A new wafer dicing machine is described. Residual beta activities of tritiated wafers were determined using 4-pi geometry and the results are summarized. Further investigations on the inversion recovery kinetics of deuterated transistors, EPR experiments on thermally grown silicon dioxide, and process contributions to dielectric defects in oxide layers are discussed. R.N.A.

N66-37224*# Rochester Univ., N. Y. Inst. of Optics.
PROPERTIES OF MULTILAYER FILTERS Interim Report, 1 Sep. 1965–28 Feb. 1966
P. W. Baumeister [1966] 29 p refs
(Grant NsG-308-63)
(NASA-CR-78144) CFSTI: HC $2.00/MF $0.50 CSCL 09A

The circuitry and calibration of a solenoid-actuated shutter for the rapid firing of aluminum is described. An ultraviolet band-pass filter with an improved peak transmittance and narrower band width is designed. The filter consists of the conventional metal-dielectric-metal type filter augmented with dielectric stacks on either side of the metal layer: air (diel. stack) M (spacer) M (diel. stack) substrate. If M represents a 150Å thick aluminum layer, a computed peak transmittance of 80% is attained. Author

N66-37251# Naval Applied Science Lab., Brooklyn, N. Y.
INVESTIGATION OF PLATINGS OF ELECTRICAL CONTACTS
8 Jul. 1966 29 p refs
(TM-1; AD-636193) CFSTI: HC $2.00/MF $0.50

MIL-C-26636 size 16 and 20 pin and socket contacts were electroplated with gold over silver, gold over nickel, gold over copper, rhodium over nickel, and rhodium over silver. Plated contacts were wired and assembled in a modified louvered stevenson screen and installed at the NASL marine environmental site at Ft. Tilden, N. Y. mounted on a supporting structure facing the ocean without obstruction, approximately 500 feet from the shore line and 40 feet above M.L.W. Analysis of tarnish films deposited on exposed copper plates during the initial two months at the Ft. Tilden test site indicates a suitable marine environment free of sulphide contamination. Contact resistance measurements on contacts mated 100 times as compared to contacts mated once, prior to exposure, show no significant difference except for a 30% increase for those plated with rhodium over nickel. The contact resistance

measurements made during the first two months of exposure indicate a slight increase in the average contact resistance of all contacts. Author (TAB)

N66-37312*# Hughes Aircraft Co., Newport Beach, Calif. Solid State Research Center.
DEVELOPMENT OF A THIN-FILM SPACE-CHARGE-LIMITED TRIODE Final Report, Mar. 1965–Jun. 1966
R. Zuleeg and P. Knoll Jun.1966 171 p refs
(Contract NAS12-5)
(NASA-CR-78149) CFSTI: HC $5.00/MF $1.00 CSCL 09A

Experimental and theoretical research and development of a thin-film space-charge-limited triode is presented. This includes experimental results of thin-film CdS-Si and GaAs-Si heterojunction transistors operating under space-charge-limited emitter current; a method to determine the density of states at a heterojunction interface; the design and electrical measurements of a thin-film space-charge-limited triode in the dielectric surface gate structure employing the silicon-on-sapphire technique; the film properties of CdS, GaAs, and Si; correlation of electrical results with the device physics and structure and finally discussion and conclusions based upon the electrical results with the device physics and structure and finally discussion and conclusions based upon the electrical characteristics established with the device structures fabricated. The limitations of the device structures investigated are assessed with respect to frequency and temperature of operation and the results extrapolated to device structures feasible in the near future by employing improved photolithographic and material technology. Author

N66-37314*# Rensselaer Polytechnic Inst., Troy, N. Y. Dept. of Electrical Engineering.
STUDY IN OPTIMIZATION OF MICROCIRCUIT DESIGN Final Report
S. K. Ghandhi, D. N. Arden, F. L. Thiel, E. Henry, and R. Wooley
1 Jul. 1966 149 p refs
(Contract NAS12-34)
(NASA-CR-78049) CFSTI: HC $4.00/MF $1.00 CSCL 09A

Problems pertaining to aspects of device technology, circuit design, and logical design that directly influence the reliable operation of a microcircuit subsystem are investigated. Activities included study of the use of nickel as a substitute for gold in fabrication of high-speed microcircuits, the noise immunity of high-speed saturated logic microcurcuits, and oscillation hazards in asynchronous sequential circuits. It is shown that nickel can be used to reduce lifetime to the level normally required in high-speed switching devices. However, the behavior of nickel in silicon is considerably more complex than that of gold due to effects at both extremes of the diffusion temperature range. A new method is proposed for characterizing the performance of saturated logic gates to noise pulses. It was concluded that asynchronous circuits cannot be reliably constructed from very fast logical devices if simultaneous input changes are possible, unless some method is available for eliminating short pulses in the feedback loops. S.P.

N66-37324*# Santa Barbara Research Center, Goleta, Calif.
FIVE-CHANNEL SCANNING RADIOMETER Quarterly Reports 17, 18, and 19, 15 Oct. 1964–15 Jul. 1965
F. R. Malinowski 5 Aug. 1965 93 p *Its* Rept.-2060-Q17-18-19
(Contracts NAS5-757; NAS5-3648)
(NASA-CR-78174) CFSTI: HC $3.00/MF $0.75 CSCL 09C

Calibration of the F-5 and F-6 medium resolution infrared radiometers (MRIR) was completed. Graphs which show the calibration curves obtained from these measurements for five radiometer temperatures are provided. Check-of-calibration measurements were made on the F-2 MRIR after the radiometer has been subjected to orbital simulation testing. The data obtained were in good agreement with the final calibration data previously obtained. High vacuum, high temperature, UV radiation testing was completed on a sample 14 to 16 micron filter. No degradation in filter transmission characteristics was detected as a result of this environmental exposure. H.S.W.

N66-37363*# Stanford Research Inst., Menlo Park, Calif.
RESEARCH ON COLD CATHODES Final Report
D. V. Geppert and B. V. Dore May 1966 57 p refs
(Contract NAS5-9581)
(NASA-CR-78261) CFSTI: HC $3.00/MF $0.50 CSCL 09A

The requirements for the semiconductor, metal surface film and activator for the surface-barrier cathode are reviewed. The studies on GaP crystals and GaP/metal surface-barrier diodes conducted during the course of the program are reviewed and discussed. The activation experiments involving the evaporation of thin films of BaO on various metals are then reviewed and discussed. The recent experiments on nickel substrates indicate very-high-quantum-efficiency photoemission at elevated cathode temperatures. The promising emission results obtained during the last quarter from transverse field emitters are presented. Alphas approaching 50 percent were obtained by subjecting thin films of evaporated BaO to high transverse fields ($>10^5$V/cm). These cathodes were operated under dc conditions, and emission current densities as high as about 1 amp/cm^2 were obtained. Author

N66-37401# Radio Corp. of America, Camden, N. J. Communications Systems Div.
MICROMODULE LIFE TEST PROGRAM Fifth Progress Report, 17 Sep. 1965–15 Apr. 1966
F. E. Farmar [1966] 65 p refs
(Contract DA-36-039-AMC-01462(E))
(Rept.-5; AD-636283) CFSTI: HC $3.00/MF $0.75

Progress is reported on a micromodule life test program to determine the mean-time-to-failure (MTTF) of a typical analog and a typical digital micromodule when tested for ten-thousand (10,000) hours under load at elevated temperature. The causes of micromodule failure during test are to be determined and reported to each supplier of test modules, and at the conclusion of testing, drift characteristics of each micromodule parameter are to be studied to determine attainable tolerance limits for these parameters. TAB

N66-37428# Centre de Physique Electronique et Corpusculaire, Orsay (France).
HALF MILLIMETER "BACKWARD WAVE OSCILLATION" Fourth Technical Progress Report, 1 Jan.–31 Mar. 1966
Yeou Ta Apr. 1966 25 p
(Contract AF 61(052)-814)
(WR-1561; RADC-TR-66-450; AD-635627) CFSTI: HC $1.00/MF $0.50

The objective of the work was to construct a half-millimeter backward-wave oscillator, with a power level in the range of half a watt. An electron gun, with a beam of about 0.07 millimeter in diameter, was designed and tested. A new type of increased reserve cathode gave encouraging results but should be verified over the high density range. TAB

N66-37433# Applied Physics Lab., Johns Hopkins Univ., Silver Spring, Md.

EFFECT OF FREQUENCY VARIATION ON THE ACCURACY OF A SYNCHRO-TO-DIGITAL CONVERTER

Kenneth S. Bonwit (M.S. Thesis—Maryland Univ.) Apr. 1966 88 p refs

(Contract NOw-62-0604-c)

(TG-818; AD-635964) CFSTI: HC $3.00/MF $0.75

A description is presented of the operation of a particular synchro-to-digital converter. A synchro-to-digital converter is a special form of an analog-to-digital converter which accepts at its input an analog three-wire synchro input with voltages representing the synchro shaft angle and provides a binary digital output which represents that angle. An analytical expression is developed which permits the determination of the error in the synchro-to-digital converter (on the basis of stated assumptions). The effects of the third-harmonic and quadrature signal components of the synchro input signal have been included. The magnitudes of these components may be varied by varying corresponding parameters in the expression. The errors for a wide range of frequencies were calculated in a general-purpose digital computer, and the results are presented graphically. An explanation of the cause of the error variation is presented. In addition, there is a discussion of the effects on the converter error of the variation of the parameters in the analytical expression. Author (TAB)

N66-37545*# Bendix Corp., Southfield, Mich. Research Laboratories Div.

STUDY TO INVESTIGATE THE EFFECTS OF IONIZING RADIATION ON TRANSISTOR SURFACES Fourth Quarterly Report, Period Ending Jun. 30, 1966

Richard J. Sweet and David L. Nelson 15 Jul. 1966 54 p refs *Its* Rept.-3557

(Contract NAS8-20135)

(NASA-CR-78352) CFSTI: HC $3.00/MF $0.50 CSCL 09A

An investigation has been made of the effects of ionizing radiation on transistor I_{CBO} and h_{FE} with measuring conditions and electrical bias during irradiation as variables. Two current components were identified that affect I_{CBO} and h_{FE} at low levels: surface channel current and surface space charge region recombination-generation current. To explain variations in both h_{FE} and I_{CBO} for both n-p-n and p-n-p transistors, a model has been proposed which includes the effects of bias during irradiation. Based on test results and the model, a procedure was devised consisting of an irradiation screening test followed by temperature annealing, which enables selection of transistor types and individual transistors which are least sensitive to ionizing radiation. Author

N66-37603*# Arkansas Univ., Little Rock. Dept. of Electronics and Instrumentation.

OPERATION INSTRUCTIONS FOR THE COLD ELECTRON SOURCE Final Report, Part II

R. W. Raible, B. E. Gilliland, and W. G. Hinson 23 Sep. 1966 19 p

(Grant NsG-260)

(NASA-CR-78340) CFSTI: HC $1.00/MF $0.50 CSCL 09C

Operational and maintenance procedures are presented for a multiplier ion source that incorporates two plane-parallel, resistive surface strips to obtain secondary electron emission energies. The total gain in electron current represents a function of magnetic and electrostatic field strengths and the length of the dynode. High voltage and filament controls adjust for minimum stable output when a deuterium lamp is activated, and a control circuit regulates the electron output to present level. Replacement procedures for the dynode and other structures are outlined, as well as checking and operating procedures for the mass spectrometer and the ion gauge. G.G.

10 ELECTRONICS

Includes circuit theory; and feedback and control theory. For applications see: 09 Electronic Equipment. For related information see: Specific Physics Categories.

N66-36676# Joint Publications Research Service, Washington, D. C.

ON SELECTING OPTIMALITY CRITERIA OF REMOTE-CONTROL SYSTEMS

G. A. Shastova and A. I. Koyekin *In its* 22d All-Union Sci. Session Devoted to Radio Day. Sect. on Telemech. 18 Aug. 1966 p 85–92 refs (See N66-36666 22-07) CFSTI: $5.00

Attention is given to the determination of optimum parameters of remote control information systems, specifically the problems related to determining the (1) optimum reliability level of individual units of a complex control system of prescribed structure, (2) optimum volume of information to be transmitted and processed in the control system, and (3) optimum information structure itself. The latter, for which research has just begun, is considered very complex, especially if it includes the search for optimum distribution of functions between different stages of control. The effect of information distortions on the control process is determined by a control algorithm, the formulation of which is detailed. M.W.R.

N66-36677# Joint Publications Research Service, Washington, D. C.

ON THE SELECTION OF THE STRUCTURE OF COMPLEX REMOTE-CONTROL SYSTEMS

V. A. Il'in *In its* 22d All-Union Sci. Session Devoted to Radio Day. Sect. on Telemech. 18 Aug. 1966 p 93–100 refs (See N66-36666 22-07) CFSTI: $5.00

Examples are given to illustrate the optimization of the hierarchal structure of complex remote control systems. The selection of the hierarchal structure is reduced essentially to the selection of coefficients of hierarchy at each stage of control, and in industrial systems these coefficients must be optimized in accordance with complex economic criteria. Therefore, the optimization method considers components of economic loss, such as damage detection. M.W.R.

N66-36680# Joint Publications Research Service, Washington, D. C.

FREQUENCY CONVERTERS WITH CONTROLLED CONVERSION COEFFICIENT

M. A. Rakov *In its* 22d All-Union Sci. Session Devoted to Radio Day. Sect. on Telemech. 18 Aug. 1966 p 118–126 refs (See N66-36666 22-07) CFSTI: $5.00

Automatic adjustment of an internal generator via a pulse-phase detector is considered for use in frequency conversion schemes to detect both fundamental frequency and multiple frequencies. A formula is given for determining the constant voltage component at the output of a synchronous phase detector, and the phase detector's operation is considered for a characteristic square-shaped input signal. Two possible block diagrams of frequency converters with controlled conversion coefficients are presented, and converter operation is discussed. Attention is also given to controlling the magnitude of the frequency conversion coefficient, and a concrete frequency converter circuit is diagrammed. The discussion is considered applicable to controlled analog code converters as well as to the construction of elements with many stable states. M.W.R.

N66-36681# Joint Publications Research Service, Washington, D. C.
METHOD OF VARYING THE LENGTH OF BRIDGE-ELEMENT DELAY (BED)
Z. N. Krikun *In its* 22d All-Union Sci. Session Devoted to Radio Day. Sect. on Telemech. 18 Aug. 1966 p 127–134 refs (See N66-36666 22-07) CFSTI: $5.00

A reference voltage method, proposed for changing the length of Bridge-Element Delay (BED), is considered to have advantages in cases where several elements in the distribution must be changed simultaneously. The reference voltage value is established for the distributor as a whole, and changes can be made over a wide range without altering the initial values of the parameters of an RC circuit. Results of the BED analysis indicate that the range in delay length fluctuation has an upper limit which is determined by the finite sensitivity of the current amplifier, and the threshold voltage of the diode connected to the bridge diagonal. Lower limits are caused by the speed of transistor response and, consequently, the minimum length of the leading edge of the pulse; as well as by the minimum value of the output signal voltage. M.W.R.

N66-36683# Joint Publications Research Service, Washington, D. C.
CALCULATING THE PARAMETERS OF A PULSE MAGNETIC ELEMENT UNDER CAPACITIVE LOAD
V. V. Naumchenko *In its* 22d All-Union Sci. Session Devoted to Radio Day. Sect. on Telemech. 18 Aug. 1966 p 144–153 refs (See N66-36666 22-07) CFSTI: $5.00

Linear elements or elements of single-cycle distributors are cited as examples of pulse magnetic components of noncontact telemechanical systems for which the parameters under capacitive loading are calculated. A system of differential equations is given for describing the process of remagnetizing the element by square pulses, assuming a loss-free core with ideally rectangular hysteresis loop. Expressions are included for finding magnetic flux and capacitance voltage, the time required for complete core remagnetization, and capacitance voltage on termination of core remagnetization; as well as for the relationships between the various parameters. The relative change of capacitance voltage is determined, and it is noted that sometimes the most important operating parameter is the value of energy stored up by the capacitor rather than voltage. M.W.R.

N66-36690# Joint Publications Research Service, Washington, D. C.
EXPERIMENTAL AND PRACTICAL APPLICATIONS OF CYBERNETIC SYSTEMS
T. Gergey et al 15 Sep. 1966 30 p refs Transl. into ENGLISH from Avtomat. (Kiev), v. 10, no. 3, 1966 p 24–48 (JPRS-37627; TT-66-34055) CFSTI: $2.00

CONTENTS:

1. THE CHOICE OF STYLE OR LANGUAGE OF RANDOM PERCEPTRON PROTOTYPES T. Gergey, O. G. Ivakhnenko, and G. A. Lemishevs'kyy p 1–12 refs
2. ASSAYING OPTIMUM PARAMETER VALUES OF ONE-STAGE SYSTEMS OF PROCESSING OPERATIVE INFORMATION A. S. Podakov p 13–19 refs
3. USING A KOLMOGOROV–WIENER FILTER FOR STATISTICAL PREDICTION OF FLOOD VOLUME ON THE DESNA RIVER V. N. Stepanenko p 20–26 refs

N66-36726# Joint Publications Research Service, Washington, D. C.
THEORY OF LARGE SYSTEMS IN TECHNICAL CYBERNETICS
Ya. Z. Tsypkin and P. Ya. Vol'skiy, ed. 17 Aug. 1966 63 p refs Transl. into ENGLISH from the book "Tekhnicheskaya Kibernetika" Moscow, 1965 p 287–325 (JPRS-37077; TT-66-33508) CFSTI: $3.00

CONTENTS:

1. METHOD OF CUTS IN TRANSPORT NETWORKS V. N. Burkov p 1–12 refs (See N66-36727 22-10)
2. THE RETINA AS AN OBJECT OF BIONIC STUDY G. V. Voronin p 13–25 refs (See N66-36728 22-10)
3. SOME PROBLEMS IN THE THEORY OF SYSTEMS L. M. Dronfort, S. G. Oradovskaya, and V. B. Sokolov p 26–30 ref (See N66-36729 22-10)
4. GEOMETRY THEOREM-PROVING MACHINE L. M. Timofeyeva p 31–45 refs (See N66-36730 22-10)
5. THEORETICAL-INFORMATION ESTIMATORS OF THE LEARNING PROCESS Yu. I. Shmukler p 46–57 (See N66-36731 22-10)

N66-36727# Joint Publications Research Service, Washington, D. C.
METHOD OF CUTS IN TRANSPORT NETWORKS
V. N. Burkov *In its* Theory of Large Systems in Tech. Cybernetics 17 Aug. 1966 p 1–12 refs (See N66-36726 22-10) CFSTI: $3.00

A method utilizing graphs cuts for a transport network (a connected graph) is described, and algorithms are given for determining the minimum paths between nodes on the graph. The proposed algorithms have the feature that the problem is solved directly by a picture of the network without shifting to any other description (the areas are used for describing the numbers). In addition, a solution is obtained without a gradual increase in any flow, and the maximal flow is immediately constructed. The algorithm is particularly effective when area node x_0y is a plane graph or when there is a small number of lines in the T set for the general case. L.S.

N66-36728# Joint Publications Research Service, Washington, D. C.
THE RETINA AS AN OBJECT OF BIONIC STUDY
G. V. Voronin *In its* Theory of Large Systems in Tech. Cybernetics 17 Aug. 1966 p 13–25 refs (See N66-36726 22-10) CFSTI: $3.00

The structural features of the retina are described, and the total biopotential of prepared frog eye retinas was studied by means of an electroretinogram (ERG). The analog circuit of the ERG is depicted. Similarities and differences between the reactions of the analog circuit and the prepared retinas to various sinusoidal stimuli are discussed. L.S.

N66-36729# Joint Publications Research Service, Washington, D. C.
SOME PROBLEMS IN THE THEORY OF SYSTEMS
L. M. Dronfort, S. G. Oradovskaya, and V. B. Sokolov *In its* Theory of Large Systems in Tech. Cybernetics 17 Aug. 1966 p 26–30 ref (See N66-36726 22-10) CFSTI: $3.00

A sample problem is given to illustrate the use of an algebraic approach method for solving a system problem. One approach is mentioned which treats a system as a subset of states represented as the direct product of a finite number of sets. This approach leads to studying the states themselves and not the system behavior. The present approach makes it possible to consider system behavior, and would be useful for constructing a theory of abstract systems. L.S.

N66-36730# Joint Publications Research Service, Washington, D. C.
GEOMETRY THEOREM-PROVING MACHINE

L. M. Timofeyeva *In its* Theory of Large Systems in Tech. Cybernetics 17 Aug. 1966 p 31–45 refs (See N66-36726 22-10) CFSTI: $3.00

The concept and structure of a geometric theorem-proving machine, consisting of three computing devices (syntactic, diagrammatic, and heuristic), used for solving geometrical logic-type problems, is described. The solution of the logic problem can be represented as a tree-like structure. Methods for abridging the run-through along the solution tree are discussed; formulas are outlined for constructing a set of syntactic symmetries. L.S.

N66-36731# Joint Publications Research Service, Washington, D. C.

THEORETICAL-INFORMATIONAL ESTIMATORS OF THE LEARNING PROCESS

Yu. I. Shmukler *In its* Theory of Large Systems in Tech. Cybernetics 17 Aug. 1966 p 46–57 (See N66-36726 22-10) CFSTI: $3.00

An automatic approach to problems of the learning process for systems having different matrix assemblies and probability distributions is presented. A system described by the ensemble of all possible matrices (complete learning), and a system having restricted ensemble of particles, are discussed. The mappings and informational estimators involved in extracting the probability information required, are described in detail. L.S.

N66-36735# Joint Publications Research Service, Washington, D. C.

TWENTY-SECOND ALL-UNION SCIENTIFIC SESSION DEVOTED TO RADIO DAY. SECTION ON ELECTRONICS

19 Aug. 1966 160 p refs Transl. into ENGLISH of the Publ. "XXII Vsesoyuznaya Nauchnaya Sessiya, Posvyashchennaya Dnyu Radio, Sektsiya Elektroniki" Moscow, 1966 p 3–127

(JPRS-37117; TT-66-33546) CFSTI: $4.00

Articles on theoretical and applied electronics are presented. For individual titles see N66-36736–N66-36755.

N66-36736# Joint Publications Research Service, Washington, D. C.

DETERMINING THE BASIC CHARACTERISTICS OF THE AMPLITRON IN APPROACHING A RIGID SPOKE

V. N. Galimullin and P. V. Romanov *In its* 22d All-Union Sci. Session Devoted to Radio Day. Sect. on Electron. 19 Aug. 1966 p 1–9 refs (See N66-36735 22-10) CFSTI: $4.00

A method for estimating the basic characteristics of an amplitron is expanded for the case of a rigid spoke. It is assumed that the instruments operate on a limited space charge, and that the formation of the electron spoke is determined by the mean high frequency field in the sphere of interaction. Equations are given for estimating the dispersion characteristics and coupling resistance of the decelerator in the range of synchronous frequency. If deviation from synchronization is slight and the amplitude of the frequency field is sufficiently high, the electrons stay within the limits of a given decelerating wave. With great synchronization deviation and weak field, the spoke becomes so warped that some of the electrons do not reach the anode. Instead, their velocity sign is reversed and they return to the cathode; and the decreased current at the cathode causes a drop in the amplitude of the high frequency field, which causes further distortion of the spoke and an eventual collapse of amplification. M.W.R.

N66-36737# Joint Publications Research Service, Washington, D. C.

A METHOD OF ESTIMATING THE ANALYSIS AND BASIC CHARACTERISTICS OF THE AMPLITRON

I. N. Khlebnikov *In its* 22d All-Union Sci. Session Devoted to Radio Day. Sect. on Electron. 19 Aug. 1966 p 10–19 refs (See N66-36735 22-10) CFSTI: $4.00

Neutralization of the UHF potential in the amplitron's sphere of interaction is used for determining the basic characteristics of the amplitron. Expressions are obtained for the coefficient of amplification, output power, and efficiency on the basis of the theory of space charge and in terms of identical electron spokes. After a statement of the initial hypothesis for the method, which assumes that the spoke is symmetrical with respect to its geometrical axes and that the average densitity of the charge in each radial layer of the spoke is constant as it moves around the cathode, the determination of induced current is discussed, and an evaluation is made of the radial component of induced current for tapering spokes. The obtained data are graphed to show the applicability of the proposed method for calculating the characteristics and parameters of the amplitron under operating conditions. M.W.R.

N66-36738# Joint Publications Research Service, Washington, D. C.

THE STATISTICAL THEORY OF THE CYLINDRICAL MAGNETRON

V. E. Belov and L. V. Rodygin *In its* 22d All-Union Sci. Session Devoted to Radio Day. Sect. on Electron. 19 Aug. 1966 p 20–29 refs (See N66-36735 22-10) CFSTI: $4.00

Bidromichiskie and multilayer conditions are considered in relation to the statistical theory of the cylindrical magnetron. A set of differential equations is given for the determination of the electron movement in the cylindrical magnetron at zero initial velocity, and averaging is employed in the solution. Analysis of the equations in the first improved approximation shows that the radial electron travel is characterized by alternating acceleration and deceleration. The total electron velocity has both a radial and a transversal component. Conditions which require two or more parameters for their description are referred to as multilayer because they have so-called suspended layers of electrons in addition to the one which is next to the cathode; and some examples of these conditions are noted. M.W.R.

N66-36749# Joint Publications Research Service, Washington, D. C.

THE INTERACTION OF SPIRAL ELECTRON STREAMS WITH STATIONARY WAVES OF LARGE CAPACITIES

G. N. Rapoport and V. A. Zhurakhovskii *In its* 22d All-Union Sci. Session Devoted to Radio Day. Sect. on Electron. 19 Aug. 1966 p 100–107 refs (See N66-36735 22-10) CFSTI: $4.00

Electron travel in the field of a stationary electromagnetic wave is investigated, and equation systems are evolved for determining the interaction of spiral electron stream with large capacity stationary waves. The system of travel equations is solved by the Runge–Kutta method of the fourth order; and in this way each layer of the electron stream is simulated by the width of the halfwave by eight infinitely thin layers of charged particles. The main purpose of the study is to find the optimum system parameters which will provide maximum efficiency for designing UHF generators with spiral electron streams, and various calculations and graphs illustrate that this can be accomplished. M.W.R.

N66-36750# Joint Publications Research Service, Washington, D. C.

EXCITATION OF THE TEM FIELD BY RESTRICTED SPIRAL ELECTRON STREAMS

A. A. Kyraev *In its* 22d All-Union Sci. Session Devoted to Radio Day. Sect. on Electron. 19 Aug. 1966 p 108–116 (See N66-36735 22-10) CFSTI: $4.00

Equations are presented for the use in determining the excitation of traveling electromagnetic (TEM) waves by restricted spiral streams. An expansion is included for the solution of the nonuniform vector wave equation, and the formula is given for the determination of the amplitude of the excited wave through the electron trajectories. The starting conditions of the generator with a TEM field are computed by treating the counter wave as an unperturbed wave of constant amplitude, and the mechanism of self-excitation of the TEM-field generator is discussed. It is noted that the counter wave differs very little in phase and amplitude from one that is given in zero approximation, thereby limiting errors due to computation. It is concluded that the restricted uniform magnetic fields that exist in free space, and the streams of charged particles entrapped by these fields, should result in radio emission. M.W.R.

N66-36751# Joint Publications Research Service, Washington, D. C.

MEASURING THE PARAMETERS OF THE LBV SPACE CHARGE

B. S. Dmitriev, Iu. D. Zharkov, and L. Ia. Maiofis *In its* 22d All-Union Sci. Session Devoted to Radio Day. Sect. on Electron. 19 Aug. 1966 p 117–120 refs (See N66-36735 22-10) CFSTI: $4.00

Preliminary results are presented for the measurement of the reduction coefficient of the plasma frequency of a space charge (designated LBV). Based on the effect of infinite attenuation of the LBV signal, the measurement methods permits determination of the various parameters of the space charge, and length of the interaction, phase constants of the wave and beam, and cyclic frequency of the signal of the relative travel angle are shown in relation to the plasma frequency of a beam of finite dimensions. Experimental studies were conducted on a space charge with a needle-type cylinder, with focusing of the beam accomplished by a longitudinal magnetic field of 800 oerstads to enable the radius of the beam to be equal to that of the cathode. The coefficient of current passage was .98 to .99 at an operating current of 200 to 400 microamperes and an acceleration of 1600 to 2500 volts. Distributed attenuation in the operating frequency range of 1500 to 3000 megacycles varied from three to seven decibels. One of the main difficulties encountered was in measuring the differences between the phase constants of the beams and waves. M.W.R.

N66-36752# Joint Publications Research Service, Washington, D. C.

THE NON-LINEAR THEORY OF MULTIPLICATION OF THE LAMP OF A TRAVELING "O" TYPE WAVE OF GREAT AMPLIFICATION

V. A. Malyshev *In its* 22d All-Union Sci. Session Devoted to Radio Day. Sect. on Electron. 19 Aug. 1966 p 121–126 refs (See N66-36735 22-10) CFSTI: $4.00

Series approximations are used to compute the field of the *n* harmonic excited by the *n* harmonic of the current for a lamp with a traveling O-type wave of great amplification. These computations yield expressions for the active component of the interaction strength which determine the multiplying properties of the space charge. Braking systems of low dispersion are considered, and it is found as the number of harmonics increases, the maximum of output powers occurs for fewer input signals. It is noted that a similar event occurs in klystron multipliers. M.W.R.

N66-36753# Joint Publications Research Service, Washington, D. C.

THE COUPLER OF FUNDAMENTAL WAVES AND THE ROLE OF DISPERSION IN PARAMETRIC AMPLIFICATION ON THE TRAVELLING WAVE

Iu. K. Barsukov *In its* 22d All-Union Sci. Session Devoted to Radio Day. Sect. on Electron. 19 Aug. 1966 p 128–133 refs (See N66-36735 22-10) CFSTI: $4.00

In discussion the role of dispersion on the parametric amplification of a traveling wave, it is noted that there is a rapid increase of the diagonal coefficients of waves which have direct couplings with the frequency wave of the signal. In the absence of dispersion in the frequency range because no coupling exists, dispersion in the near band is stronger. It is the strength of the dispersion which determines the number of fundamental waves, and this number can be expressed quantitatively by series substitutions. M.W.R.

N66-36754# Joint Publications Research Service, Washington, D. C.

THEORETICAL AND EXPERIMENTAL STUDIES OF STRONGLY COUPLED STRAIGHT-ANGLE SPACE CAVITIES

Zh. F. Pashehenko and A. I. Tereshehenko *In its* 22d All-Union Sci. Session Devoted to Radio Day. Sect. on Electron. 19 Aug. 1966 p 134–138 refs (See N66-36735 22-10) CFSTI: $4.00

A method called "fundamental functions" is described for the opening of the coupling in computing the parameters of strongly coupled straight-angle space cavities. Essentially, this method consists of expressing the tangential components of the fields on the coupling surface openings as rows of coordinate functions which satisfy the boundary conditions of the contour opening. To test the method, experimental studies were conducted on a system of two straight-angle cavities of different dimensions; with the first cavity exciting the system. Since divergence of theoretical and experimental results does not exceed 5%, it is concluded that the suggested method is useful for computing cavities of any configuration of unlimited dimensions by a diaphragm of arbitrary form. M.W.R.

N66-36755# Joint Publications Research Service, Washington, D. C.

THE ANALYSIS AND SYNTHESIS OF DECELERATING SYSTEMS OF VARIABLE LENGTH PARAMETERS

N. F. Kupchinov and V. A. Malyshev *In its* 22d All-Union Sci. Session Devoted to Radio Day. Sect. on Electron. 19 Aug. 1966 p 139–145 refs (See N66-36735 22-10) CFSTI: $4.00

One of the methods of studying the dispersion properties of decelerating systems of slowly changing parameter lengths is examined, and solutions are given in terms of approximations of the traveling wave and the effect of nonuniformity on the fundamental space harmonic. The braking system is represented by an equivalent scheme in the form of series T or P tetrapoles with reactive elements of variable lengths. It is assumed that there is no reflected wave in the system, and series approximations are given for the analysis of the dispersion properties of braking systems with slowly chaning parameters. Synthesis of the deceleration problem is shown for three common cases. M.W.R.

N66-36765# Eidgenossische Technische Hochschule, Zurich (Switzerland).

INVESTIGATION OF A THYRATRON-CONTROLLED OR THYRISTOR-CONTROLLED SYNCHRONOUS MOTOR BY SIMULATION ON AN ANALOG COMPUTER

Mohamed Mahmoud Bayoumi (Ph.D. Thesis) 1963 50 p refs (Rept.-3442) CFSTI: HC $2.00/MF $0.50

Experimental examination of a thyratron controlled synchronous motor indicates that it is not possible to directly measure the instantaneous value of the electromagnetic torque or the currents in the damper windings. Mathematical analysis, which permits the investigation of the behavior of each part of the motor, was accomplished by simulation on an analog computer. Motor constants were determined, and the system was solved for single and three-phase cases. For the latter, the thyratron simulator and its advantages are detailed. The stator currents, voltages, and fluxes were transformed on both stationary and moving axes, thereby separating the linear and nonlinear components of the transformation. Oscillograms were taken for the instantaneous value of the electromagnetic torque, and the voltage across the thyratrons in both the transient and steady states. The effect of sudden variation in applied voltage on the different oscillograms is shown. M.W.R.

N66-36782*# National Aeronautics and Space Administration. Marshall Space Flight Center, Huntsville, Ala.

EXTENSION OF POPOV'S THEOREMS FOR STABILITY OF NONLINEAR CONTROL SYSTEMS

Y. H. Ku and H. T. Chieh 23 Jun. 1966 26 p refs

(NASA-TM-X-53477) CFSTI: HC $2.00/MF $0.50 CSCL 09C

Popov's Theorem PI is introduced and then a new Theorem I is formulated. The proof is given in appendix I. An illustrative example shows that the result obtained from Theorem I agrees with that obtained from Lur'e's Theorem. Popov's Theorem PII is extended to form a new Theorem II, which gives the condition for quasi-asymptotic stability. Two corollaries are also given. Corollary IIa gives the condition for asymptotic stability. The proof of Theorem II and its corollaries is given in appendix II. Three examples check with the results of analog computer studies. Author

N66-36893# Joint Publications Research Service, Washington, D. C.

CYBERNETICS AND CONTROL THEORY

25 Aug. 1966 17 p refs Transl. into ENGLISH from Dokl. Akad. Nauk SSSR (Moscow), v. 167, no. 6, 1966 p 1245-1250

(JPRS-37221; TT-66-33650) CFSTI: $1.00

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1. THE CONTROLABILITY OF DYNAMIC SYSTEMS Yu. M.-L. Kostyukovskiy p 1-6 refs (See N66-36894 22-10)

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N66-36894# Joint Publications Research Service, Washington, D. C.

THE CONTROLABILITY OF DYNAMIC SYSTEMS

Yu. M. -L. Kostyukovskiy *In its* Cybernetics and Control Theory 28 Aug. 1966 p 1-6 refs Presented at the All-Moscow Seminar on the Theory of Multiconnected Control Systems, Moscow, 17 Feb. 1965 (See N66-36893 22-10) CFSTI: $1.00

Consideration is given to the controllability of a linear nonstationary dynamic system by establishing the correspondence between the known and newly obtained conditions of controllability at the output. These conditions are formulated in terms of the given matrices which correspond to the motion equations of the system. The motion of the dynamic system is given by the matrix equations:

$$dx/dt = A(t)x + \sum_{s=1}^{r} b^s u_s, \text{ and } y = C(t)x,$$

where x is the position vector of the system in the vector space P^n; y is the vector (the output of the system) which belongs to the vector space Q^m, $m \leq n$; $u_s(t)$ is the arbitrary piecewise continuous time function; A(t), $b^s(t)$, and C(t) are variables of the $n \times n$, $n \times 1$, and $m \times n$ type matrices; and the elements of the matrices A(t), $b^s(t)$, and C(t) have continuous derivatives up to the $(n-1)$th order inclusively. C.T.C.

N66-36895# Joint Publications Research Service, Washington, D. C.

THE COMPLETENESS CRITERION FOR PARTIAL FUNCTIONS OF THE ALGEBRA OF LOGIC AND MANY-VALUED LOGICS

R. V. Freiwald *In its* Cybernetics and Control Theory 25 Aug. 1966 p 7-10 refs (See N66-36893 22-10) CFSTI: $1.00

An investigation is presented of the sets P_k (k=2, 3, ...) of all functions $F(X_1, ..., X_n)$ such that: (1) the arguments assume the values 0, 1, ..., k-1, (2) the values of the functions also are equal to 0, 1, ..., k-1, and (3) the functions are not necessarily defined for all sets of values of the arguments. Emphasis is placed on the problem of completeness in functions which are defined everywhere. C.T.C.

N66-36923# RAND Corp., Santa Monica, Calif.

A SIMPLE PROOF OF A THEOREM ON SELF-SYNCHRONIZING AUTOMATA

Dale M. Landi Jul. 1966 5 p refs

(P-3242-1; AD-636097) CFSTI: HC $1.00/MF $0.50

A short proof is offered for verifying that a finite state, completely specified automaton is synchronized with probability 1 only if there exists a universal synchronizer for the automaton. Author (TAB)

N66-37082# Brown Engineering Co., Inc., Huntsville, Ala.

NEGATIVE RESISTANCE STUDY, PHASE I Interim Report

Curtis Culwell, E. H. Devletoglou, and L. E. Niemann, Jr. Griffiss AFB, N. Y., RADC, Jun. 1966 276 p refs

(Contract AF 30(602)-3780)

(ESD-100; RADC-TR-66-231; AD-636286) CFSTI: HC $6.00/MF $0.50

The negative resistance study examines the theory of operation, the capabilities and limitations of negative resistance devices. A survey of the basic semiconductor physics of the tunnel diode, varactor diode and step recovery diode, the equivalent circuit and the equations whose parameters are the parasitic elements of the diode and govern the design criteria are presented. Some applications of the tunnel diode, varactor diode and step recovery diode as microwave devices are: amplifiers, oscillators, frequency converters, modulators, switches, limiters, and detectors. Some of the electrical characteristics of these devices are presented. Experimental results obtained from parametric amplification using a step recovery diode are shown. Based on these results, parametric amplification by charge storage diodes is feasible. Information gained as a result of this study will be useful in the use or development of various negative resistance devices, which may yield significant improvement in communication systems performance. Author (TAB)

N66-37235# Chalmers Univ. of Technology, Goteborg (Sweden). Research Lab. of Electronics.

MEASUREMENTS ON NONLINEAR SPACE CHARGE WAVES Technical Research Report No. 55

T. M. Srinivasan 1 Oct. 1965 31 p refs /ts Tech. Note No. 7
(Contract AF 61(052)-594)
(RADC-TR-66-472; AD-635807) CFSTI: HC $2.00/MF $0.50

Results of measurements on the nonlinear ac currents in a velocity modulated confined electron beam are reported. The test vehicle is a two cavity klystron type device with an axially movable demodulator. The ac beam currents at the fundamental and at the two lowest harmonic frequencies have been measured as functions of the distance along the beam for various modulation levels and dc beam currents. The main purpose of the work is to provide experimental data in the transition range between linear space charge wave type and ballistic type behaviour of the ac beam current. The experiments are in good agreement with the nonlinear space charge wave theory. Author (TAB)

N66-37255# New York Univ., N. Y. Lab. for Electroscience Research.

A CLASS OF REALIZABLE MAXIMALLY FLAT MAGNITUDE DRIVING POINT FUNCTIONS Second Scientific Report

John F. O'Neill and Mohammed S. Ghausi May 1966 37 p refs /ts Tech. Rept.-400-132
(Contract AF 19(628)-5537)
(AFCRL-66-366; AD-635917) CFSTI: HC $2.00/MF $0.50

Maximally flat magnitude driving point functions, in spite of easily visualized applications, appear to be less well known than the corresponding transfer functions of Butterworth and other types. This article describes a class of such maximally flat immittances of various order, demonstrates their positive real character, and discusses a particular form of realization, usable up to and including order 5, which makes use of parallel connections of resonant branches for admittances and series connections of dual resonators for impedances. An application is mentioned in which the maximally flat impedance is used as an interstage to achieve a flat amplifier transfer impedance. Author (TAB)

N66-37430# Colorado Univ., Boulder. Dept. of Electrical Engineering.

THE EFFECT OF INJECTION SYSTEM DYNAMICS OF LIMITING CURRENT BEHAVIOR IN AN IDEAL PLANAR DIODE

J. C. Twombly and A. G. Cerveira 1 May 1966 56 p refs
(Contract Nonr-1147(06))
(TR-4; AD-635936) CFSTI: HC $3.00/MF $0.50

The report describes an improvement in the digital computer simulation of high perveance beams in a region confined by two equipotential parallel planes. The improvement consists in considering a triode model where the first region is an acceleration region or a cathode-grid region and the second region the usual drift region between two equipotential parallel planes. The entrance plane of the drift region (grid plane) is supposed perfectly permeable to the electrons travelling in both directions. The usual assumption of returning electron annihilation at the entrance plane is not made. The improvement was tested by comparing the results with those of the previously studied diode model (AD-603078). The triode model was also tested against errors introduced by the discrete injection of charges. The use of the triode model gave rise to problems related to the discontinuity of the acceleration when the charges pass through the grid and the effect of the space charge upon the emission of the charges from the cathode. Author (TAB)

N66-37556# France. Office National d'Etudes et de Recherches Aerospatiales, Chatillon-sous-Bagneux.

LOW-FREQUENCY, SUPERCONDUCTING OSCILLATING CIRCUIT. APPLICATION TO MEASUREMENT OF DIELECTRIC LOSSES AT VERY LOW TEMPERATURE [CIRCUIT, OSCILLANT SUPRACONDUCTEUR EN BASSE-FREQUENCE APPLICATION A LA MESURE DES PERTES DIELECTRIQUES AUX TRES BASSES TEMPERATURES]

Jean-Francois Higounet 1966 43 p refs In FRENCH; ENGLISH Summary /ts Note Tech. No. 98
CFSTI: HC $2.00/MF $0.50

This main cause of the degradation of energy stored in an oscillating circuit is dissipation by Joule effect within the coil. Using superconductive materials whose resistance becomes nil at very low temperature permits very high values of Q. Such circuits have been built and Q values reaching 600,000 in a frequency range from 4 kc to 150 kc have been measured. The quality of these circuits has permitted the establishment of a method for measuring the loss factor of various dielectric materials at very low temperature with a maximum sensitivity of 1.6×10^{-6}. Another application of these circuits to very stable low-frequency oscillators is considered. Author

11 FACILITIES, RESEARCH AND SUPPORT

Includes airports; lunar and planetary bases including associated vehicles; ground support systems; related logistics; simulators; test facilities (e.g., rocket engine test stands, shock tubes, and wind tunnels); test ranges; and tracking stations.

N66-36505# Deutsche Forschungsanstalt fur Luft- und Raumfahrt, Brunswick (West Germany).

THE DFL-TELEMETRY GROUND STATION FOR PROBLEMS IN SPACE RESEARCH [DIE DFL-TELEMETRIE-BODENSTATION FUER FORSCHUNGSAUFGABEN IN DER RAUMFAHRT]

W. Benecke, H. Bothe, D. Janssen, Chr. Johansen, H. Keese et al Mar. 1966 97 p refs In GERMAN; ENGLISH summary
(DLR-Mitt.-66-05) CFSTI: HC $3.00/MF $0.75

A telemetry ground station is described, set up for telemetry research purposes in the field of aeronautics and astronautics. Tasks to be performed by this station and aspects of standardization in telemetry are outlined. Theory of operation and equipment specifications are discussed in detail from the aerial right through to the data processing equipment. A survey of the complete ground station is given. Author

N66-36511# Florida Univ., Port Canaveral.

A MULTIPATH SIMULATOR FOR USE IN EVALUATION OF SPACECRAFT RANGING AND COMMUNICATION SYSTEMS

Arnfinn Moe Manders *In* Canaveral Council of Tech. Soc. 3d Space Congr. 1966 p 69-76 (See N66-36506 22-30)

A fading channel simulator is described which is readily constructed and flexible in operation. By use of this simulator communication and ranging equipment can be tested and optimized for operation during periods of severe fading. The fading channel simulator gives fading rates varying from about 2 to 30 cps. Frequency and time scaling of the problem can be used if the fading rates of the channel to be simulated are outside this range. Author

N66-36537# Air Force Eastern Test Range, Patrick AFB, Fla.
AIR FORCE EASTERN TEST RANGE CENTRAL TELEMETRY STATION (TEL-IV)
John L. Gilbert and B. S. Chen *In* Canaveral Council of Tech. Soc. 3d Space Congr. 1966 p 409-419 (See N66-36506 22-30)

The new Central Telemetry Station at Kennedy Space Center, based on a central control technique, is described. The system setup and equipment assignment for a given mission's support is accomplished automatically by a launch coordinator through a special purpose, wired-program digital data processor and a cross-bar switching network. The systems design concept is discussed with emphasis on the automatic patching system. Operational flexibility and simultaneous initiation of recording devices are achieved by remote control. The facility is described, and details are given on the subsystems for data acquisition, receive-record, data separation and processing, tracking, and display. The station can support a total of seven missions simultaneously, including pre-launch, launch, orbital, and post-mission data processing. N.E.N.

N66-36543# International Business Machines Corp., Bethesda, Md.
AUTOMATION IN RANGE SCHEDULING
John R. Norton *In* Canaveral Council of Tech. Soc. 3d Space Contr. 1966 p 466-478 refs (See N66-36506 22-30)

An operations research model for the range scheduling function is presented. The techniques were derived from an analysis of the Eastern Test Range, however, they are applicable to many cases of the general large project scheduling problem. It is shown that certain scheduling jobs are amenable to automation, and the methodology is illustrated with test cases. H.S.W.

N66-36545# Pan American World Airways, Inc., Patrick AFB, Fla. Guided Missile Range Div.
FUTURE TRENDS FOR ETR RANGE CONTROL
Lawrence Lerner *In* Canaveral Council of Tech. Soc. 3d Space Congr. 1966 p 487-492 (See N66-36506 22-30)

The workload of the Eastern Test Range (ETR) has changed from its original mission of supporting aerodynamic launches to support of ballistic launches and now faces an era of orbital support tasks. Plans are discussed for Range Control during the coming era. The observations contained herein represent one school of thought of the many groups that are studying the ETR workload of the present and near future. Author

N66-36546# TRW Systems, Cocoa Beach, Fla. Florida Operations.
THE RANGE SAFETY PROBLEM, "A THORN IN THE FLESH"
J. R. Duffett and J. N. Thilges *In* Canaveral Council of Tech. Soc. 3d Space Congr. 1966 p 493-503 refs (See N66-36506 22-30) (See N66-36506 22-30)

The problem of range safety is defined, and means used to assess, control, and/or eliminate the risks involved in a missile flight are presented. The discussion is limited to flight safety during the period which commences with lift-off of the missile. Pad and ground safety are not included. Methods for determining a typical flight failure and control of flight termination are examined. Failure modes used in hazard evaluation to determine quantitatively the risks involved in a flight that violates the normal range safety criterion are listed. The five types are: a premature thrust termination, a hard-over tumble, a gradual turn or instantaneous impact point turn, a thrust termination failure, and a deviant or abnormal missile. The hard-over tumble failure mode is used as an example, and contributing factors are determined and evaluated. S.P.

N66-36547# National Aeronautics and Space Administration. Manned Spacecraft Center, Houston, Tex.
MISSION CONTROL CENTER—HOUSTON
R. E. Driver and J. M. Satterfield *In* Canaveral Council of Tech. Soc. 3d Space Congr. 1966 p 504-509 (See N66-36506 22-30)

Equipment and facilities for control of all NASA manned space flights at Mission Control Center—Houston (MCC-H) are described. The dual capability for providing various combinations of simultaneous real-time missions, simulation exercises, or system checkout is emphasized. Brief summaries of operation and location of the five basic systems comprising MCC-H are included for the display/control system, the real-time computer complex, the communications and command systems, and the simulation, checkout, and training system. The major implementation problem is stated as that of scheduling the MCC-H facilities to support the integrated systems tests. The problem of controlling configuration and engineering changes to accommodate last minute and real-time changes is also discussed. S.P.

N66-36560# TRW Systems, San Bernardino, Calif.
RECOVERY—AIR FORCE BALLISTIC WEAPONS SYSTEMS
Michael E. Golder *In* Canaveral Council of Tech. Soc. 3d Space Congr. 1966 p 633-640 (See N66-36506 22-30)

The facilities for the postflight recovery of a ballistic missile reentry vehicle at Eniwetok Atoll are compared with those at Kwajalein Atoll. A two man submarine is available at Kwajalein for recovery operations whereas divers are used at Eniwetok. Recovery techniques, search and diving methods, and retrival methods are discussed, and the benefits of physical recovery of the reentry vehicles are assessed. H.S.W.

N66-36561# Aerospace Rescue and Recovery Service, Orlando AFB, Fla.
RESCUE AND RECOVERY IN THE SPACE AGE
Emil G. Beaudry and John L. Vandegrift *In* Canaveral Council of Tech. Soc. 3d Space Congr. 1966 p 641-655 (See N66-36506 22-30)

The mission of the Aerospace Rescue and Recovery Service (ARRS) is outlined and related to past, present, and future space programs. The role of ARRS in local base rescue and fire suppression, pararescue, and launch-recovery operations is assessed. Rescue in space and the possibilities of search and rescue using satellites are considered. To accomplish its mission, ARRS uses the HC-54, HU-16 and the HC-97 aircraft, in addition to the HH-43 helicopter; however, it is stated that the HC-130 aircraft will become the primary fixed wing rescue aircraft. The HH-3 helicoper is slated to complement the HC-130 to form a two aircraft team for long range rescue operations. H.S.W.

N66-36725# Deutsche Forschungsanstalt für Luft- und Raumfahrt, Brunswick (West Germany). Institut für Flugfuehrung.
THE DFL-TELEMETRY GROUND STATION FOR PROBLEMS IN SPACE RESEARCH [DIE DFL-TELEMETRIE-BODENSTATION FUER FORSCHUNGSAUFGABEN IN DER RAUMFAHRT]
W. Benecke, H. Boethe, D. Janssen, Chr. Johansen, H. Keese et al Mar. 1966 97 p refs In GERMAN; ENGLISH summary
(DLR-Mitt.-66-05) CFSTI: HC $3.00/MF $0.75

A telemetry ground station is described, set up for telemetry research purposes in the field of aeronautics and astronautics. Tasks to be performed by this station and aspects of standardization in telemetry are outlined. Theory of operation and equipment specifications are discussed in detail from the aerial right through to the data processing equipment. A survey of the complete ground station is given in chapter 3. Author

N66-36811# Naval Training Device Center, Port Washington, N. Y.
A STUDY OF 3-D EFFECTS IN VISUAL SIMULATION. PHASE I: AN ANALYSIS OF THE FACTORED TRANSPARENCY METHOD Technical Report, Jan.–Nov. 1965
H. Caligiuri Jun. 1966 31 p refs
(NAVTRADEVCEN-IH-33; AD-635869) CFSTI: HC $2.00/MF $0.50

The report contains the analysis of the factored transparency film storage method of generating images of three-dimensional objects or terrain on a TV screen. The special set of factored transparencies containing the elevation and ground terrain information is read out by using a standard TV type of flying spot scanner and photomultiplier tubes. The description includes the system's deficiencies and drawbacks. Another method of three-dimensional image generation using a laser beam coherent light source is briefly described and the possible application using a hologram type of film storage media is included. Author (TAB)

N66-37022# Los Alamos Scientific Lab., N. Mex.
THE MEDIUM-ENERGY PHYSICS PROGRAM Quarterly Status Report, Period Ending 30 Apr. 1966
1 Jun. 1966 95 p
(Contract W-7405-ENG-36)
(LA-3521) CFSTI: HC $3.00/MF $0.75

During the past quarter, work has continued at a high level on the development of more efficient, more stable, and more easily constructed 805-MHz acceleration structures. In addition, a substantial effort was devoted to the 201.25-MHz drift tube structures, including the focusing quadrupoles. Design and construction of subsystems for the 805MHz amplifier to be used in the accelerator mockup experiments are progressing satisfactorily on the basis of a mid-summer completion date. The test stand will accomodate either a coaxitron or Amplitron as the final amplifier. Effort was concentrated on equipment for the Mockup Facility which would permit the control of two 805-MHz tanks and associated rf power modules. The purpose is to test the overall concepts involving computer-based control of the accelerator. Specifications for a small (8000, 16-bit word memory) digital computer were developed and a system selected. Installation of this computer and peripheral equipment is scheduled for late this year. In the meantime, interface equipment will be designed and constructed. Particle dynamics calculations on the first tank of the Alvarez linac (0.75–5.027 Mev) and the first few tanks of the waveguide linac were made to study their operation as a function of tank excitation level and particle acceleration rate. The purpose is to improve the matching of the emittance of the Alvarez linac to the acceptance of the waveguide section of the accelerator. The computer program which designs a waveguide linac was modified so that the phase velocity of the rf wave increases in steps from tank to tank rather than continuously along each tank. NSA

N66-37026*# Cornell Aeronautical Lab., Inc., Buffalo, N. Y.
GENERAL PURPOSE AIRBORNE SIMULATOR—CONCEPTUAL DESIGN REPORT
Daniel C. Clark and John Kroll Washington, NASA, Aug. 1966 244 p refs
(Contract NAS4-607)
(NASA-CR-544) CFSTI: HC $3.75/MF $1.50 CSCL 14B

A general purpose airborne simulator (GPAS) capable of both model controlled and response feedback types of variable stability operation is described. The methods are developed for calculating theoretical control loop gains for the model controlled system as a function of dynamic pressure and aircraft weight. The magnitudes of these theoretical loop gains are based on satisfying dynamic performance criteria. The results of analog computer simulations supplement the theoretical studies of the closed-loop behavior of the model controlled systems. A comparison is made of the system performance using theoretical control loop gains and the gain values estimated to be achievable in actual flight. It is concluded that the GPAS system will provide satisfactory variable stability operation using either the model controlled system or the response feedback system. The methods and techniques presented in this report are shown to be satisfactory for establishing the proper levels of control system gains to achieve the specified model controlled performance. Author

N66-37099# General Precision, Inc., Riverdale, Md. Link Group.
VIRTUAL IMAGE DISPLAY FOR SPACE FLIGHT SIMULATOR Final Report, May 1964–Jan. 1966
T. P. Neuberger, W. E. Myles, and U. W. Ludwig Wright-Patterson AFB, Ohio, AMRL, Apr. 1966 45 p refs
(Contract AF 33(615)-1826)
(AMRL-TR-66-58; AD-636270) CFSTI: HC $2.00/MF $0.50

This report describes the addition of virtual display imagery to a spacecraft rendezvous and docking simulator. The virtual image display is an optical system which accepts inputs from two image generators and produces a superimposed, virtual image. The major components of the system are a window display, two wide angle rear projection screens, a beamsplitter, a screen drive servo mechanism, and a television projection system. Installation and alighment were accomplished by positioning and leveling the basic structure, attaching the projection enclosures, and installing the window display and projection equipment. Basic operation and performance charcteristics, including the relationships of the field of view to the screen size, and the signal voltage to the range, are provided in the report. Recommendations for future improvements in the system, including expansion of the angular field of view and improvement of resolution and brightness, are also given. Author (TAB)

N66-37157# Boeing Scientific Research Labs., Seattle, Wash.
BOEING SCIENTIFIC RESEARCH LABORATORIES REVIEW NO. 15, JANUARY–JUNE 1966
George H. Tweney ed. [1966] 161 p refs
(D1-82-0560-1)

A review is presented of research activities at Boeing's Flight Sciences, Geo-Astrophysics, Mathematics Research, Plasma Physics, and Solid State Physics Laboratories. Also included are a list of symposia and lectures held during this review period and cumulative bibliography by laboratory of past research. R.N.A.

N66-37519*# Boeing Co., Huntsville, Ala. Space Div.
IMPLEMENTATIONS GUIDELINES, AIRBORNE EVALUATION EQUIPMENT, ADVANCED SYSTEM CHECKOUT DESIGN, PHASE B Final Report, 29 Jun. 1965–29 Jul. 1966
Kenneth L. Skinner and Henry N. Kaushagen 29 Jul. 1966 52 p
(Contract NAS8-20240)
(NASA-CR-78336; D5-13288) CFSTI: HC $3.00/MF $0.50 CSCL 22D

The checkout functions to be performed onboard the Saturn instrument unit and S-IVB stages were established. The mechanization, impact of the changes on the presently planned Saturn V ground support equipment and program schedules, and the design guidelines for incorporating the onboard checkout features are described. The configura-

tion, operation, and mission of the vehicle and instrument unit are summarized. The test system, developed concurrently with the functional system, and the implementation of the airborne evaluation equipment concept are discussed. The passive implementation techniques are outlined. It is pointed out that the concept will reduce the number of umbilical interconnects and quantity of support equipment, making it easier and less costly to accommodate varying configurations of vehicles at checkout complexes. N.E.N.

12 FLUID MECHANICS

Includes boundary-layer flow; compressible flow; gas dynamics; hydrodynamics; and turbulence. For related information see also: 01 Aerodynamics; and 33 Thermodynamics and Combustion.

N66-36454# Technion Research and Development Foundation, Ltd., Haifa (Israel). Dept. of Aeronautical Engineering.
EXPERIMENTAL INVESTIGATION OF SWIRLING VORTEX MOTIONS IN JETS
N. A. Chigier and A. Chervinsky [1966] 38 p refs Presented at 5th U.S. Natl. Congr. of Appl. Mech., Minneapolis, 14–17 Jun. 1966 Submitted for Publication
(TAE-53) CFSTI: HC $2.00/MF $0.50

Measurements are reported of mean axial and swirl velocities, static pressure and jet width at axial stations up to 15 orifice diameters. Mean velocity and pressure profiles are shown to be effectively similar from an axial distance of 4 diameters for weak and moderate swirl. For the case of strong swirl a vortex is generated in the region close to the orifice resulting in a displacement of the axial velocity maximum from the jet axis. After a distance of 10 diameters the influence of the vortex motion becomes small and similarity of the profiles is obtained farther downstream. Results of the decay of velocity and pressure along the axis are compared with values predicted by an approximate theory based on the integration of the Reynolds' equations of motion. Good agreement is found between results and predictions and a set of semi empirical equations is provided from which a complete description of the mean velocity and pressure fields can be obtained for swirling jets. Author

N66-36462# Hughes Aircraft Co., El Segundo, Calif. Space Systems Div.
TURBULENT MIXING OF A TWO-DIMENSIONAL FREE JET Research Report No. 10
Jason Seubold Sep. 1966 44 p refs
(SSD-60390R)

The two different sets of equations derived by Tollmein and Goertler for the two-dimensional, compressible, free jet mixing layer using the similarity assumption have been programmed for the IBM 7044, and solutions to a wide variety of problems carried out. These solutions demonstrate the validity and accuracy of the method, illustrate the effects of changes in Prandtl number and other parameters, compare results of the Tollmein and Goertler methods, and provide analytical curves used for evaluating the spreading parameter. A new correlation for spreading parameter is presented. A first-order correction for afterburning, assuming complete stoichiometric combustion at a flame front, allows the method to be applied to fuel-rich rocket exhausts. Boundary layer temperature, velocity, and concentration profiles calculated from the Tollmein equations for a number of cold and hot air jets and for rocket engines under various conditions are presented. Author

N66-36589# Michigan Univ., Ann Arbor. Lab. for Fluid Flow and Heat Transport Phenomena.
BUBBLE COLLAPSE BEHAVIOR AROUND A SHARP WEDGE IN A DIFFUSER Technical Report No. 1
Terry M. Mitchell, Charles L. Kling, and Frederick G. Hammitt Jul. 1966 35 p refs
(Grant NSF GK-730)
(Rept.-07738-TR-1)

Two theoretical models attempting to explain the damaging potential of collapsing bubbles are explored. The "shock" theory assumes that high pressures produced during collapse in the liquid adjacent to the bubble are sufficient to cause damage to nearby solid surfaces. The "jet" theory assumes that bubbles near solid surfaces collapse asymmetrically into a torus containing a central jet. This jet when properly oriented in the direction of the solid surface is assumed to be the cause of damage. Experimental data consists of high speed photographs of the cavitating field in the vicinity of a solid boundary. Results of bubble collapse analysis support the "jet" theory of collapse by showing predominantly asymmetrical collapse. Author

N66-36608# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
AERODYNAMICS OF RAREFIED GASES, COLLECTION I
S. V. Vallander, ed. 21 Mar. 1966 345 p refs Transl. into ENGLISH of the book "Aerodinamika Razrezhennykh Gazov, Sbornik I" Leningrad, Izd. Leningrad. Univ., 1963 p 1–268
(FTD-MT-64-293; TT-66-61579; AD-634805) CFSTI: HC $7.00/MF $1.75

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N66-36607# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.

EQUATIONS AND THE FORMULATION OF PROBLEMS IN AERODYNAMICS OF RAREFIED GASES

S. V. Vallander *In its* Aerodyn. of Rarefied Gases, Collection I 21 Mar. 1966 p 7–48 refs (See N66-36606 22-12) CFSTI: HC $7.00/MF $1.75

The concepts of probability of free motion generating functions, shock transformants, etc., are described for use in considering the problems of rarefied gas aerodynamics. A system of integral equations of rarefied gas aerodynamics is established which is reduced to one integral equation f=Vf for the distribution function. This equation is shown to contain the kinetic Boltzmann equation. A mathematical formulation of the problems of rarefied gas aerodynamics is outlined. The general methods for the mathematical solution of these problems are discussed. One of the methods makes a substantial advance in the aerodynamics of strongly rarefied gases and the consideration of multiple collisions of reflected atoms. A method for determining dynamic and thermal effects of a rarefied gas flow on objects immersed with the gas is shown. R.N.A.

N66-36608# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.

INTEGRAL KINETIC EQUATIONS OF THE THEORY OF MONATOMIC GASES IN THE PRESENCE OF EXTERNAL GRAVITATIONAL FORCES

A. V. Belova and S. V. Vallander *In its* Aerodyn. of Rarefied Gases, Collection I 21 Mar. 1966 p 49–58 refs (See N66-36606 22-12) CFSTI: HC $7.00/MF $1.75

A system of equations is established which is a generalization of the kinetic integral equations concerning the motion of gas when it is acted upon by a constant external gravitational force field. Due to the exponential character of the decrease in the free motion probability, the equations are also valid in variable fields of force, if the fields change negligibly over distances of the order of 5–10 mean free paths and during intervals of time of the order of 5–10 mean time intervals between collisions of atoms. R.N.A.

N66-36609# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.

INTEGRAL KINETIC EQUATIONS FOR THE MIXTURE OF GASES WITH INTERNAL DEGREES OF FREEDOM

S. V. Vallander and A. V. Belova *In its* Aerodyn. of Rarefied Gases, Collection I 21 Mar. 1966 p 59–68 refs (See N66-36606 22-12) CFSTI: HC $7.00/MF $1.75

Integral kinetic equations are obtained for a mixture of multiatomic gases whose motion can be accompanied by chemical reactions and which move within a constant external gravitational force field. R.N.A.

N66-36610# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.

GENERAL FORMULATION OF PROBLEMS OF AERODYNAMIC FLOW AND THE CONDITIONS OF SIMILARITY FOR FLOWS OF MIXTURES OF RAREFIED GASES WITH INTERNAL DEGREES OF FREEDOM

S. V. Vallander *In its* Aerodyn. of Rarefied Gases, Collection I 21 Mar. 1966 p 69–83 refs (See N66-36606 22-12) CFSTI: HC $7.00/MF $1.75

A system of integral equations is used to formulate the aerodynamic problems of rarefied gases and to indicate the conditions of similarity of their flows. These two questions are solved in reference to certain typical problems of the aerodynamics and for a general case of the motion of gas mixtures with internal degrees of freedom. Also studied are cases of gas motion in which chemical reactions, connected with two body collisions between microscopic particles, take place. It is assumed that ionization and gravitational forces are absent. The typical problems of aerodynamics considered include the problem of flow around a finite group of bodies of finite dimensions by a flow which becomes uniform at infinity, and the problem of flow around an infinite lattice of profiles by a uniform flow specified in front of the lattice. It is shown that the specific character of the problem formulations and the criteria for the similarity are sufficiently revealed by these typical problems of aerodynamics. R.N.A.

N66-36611# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.

INTEGRAL KINETIC EQUATIONS WITHIN AN ARBITRARY CONSERVATIVE FIELD OF EXTERNAL GRAVITATIONAL FORCES

S. V. Vallander, E. A. Gurmuzova, and B. V. Filippov *In its* Aerodyn. of Rarefied Gases, Collection I 21 Mar. 1966 p 84–87 refs (See N66-36606 22-12) CFSTI: HC $7.00/MF $1.75

A system of integral kinetic equations is obtained which describe the motion of a mixture of gases with internal degrees of freedom in an arbitrary conservative field of gravitational forces. R.N.A.

N66-36612# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.

AN ALTERNATIVE FORMULATION OF THE NON-STEADY KINETIC EQUATIONS

B. V. Filippov *In its* Aerodyn. of Rarefied Gases, Collection I 21 Mar. 1966 p 88–95 refs (See N66-36606 22-12) CFSTI: HC $7.00/MF $1.75

Integral kinetic equations are derived which describe the nonsteady motion of a gas and which are adjusted for solving nonsteady problems in their natural setting when for the initial instant of time the distribution function is given. It is shown that these equations follow those of S. V. Vallander and are their alternative. However, they have a noticeable advantage when examining nonsteady problems. R.N.A.

N66-36613# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.

THE RELATIONSHIP BETWEEN THE EQUATIONS OF KINETIC THEORY OF GASES

V. A. Tsibarov *In its* Aerodyn. of Rarefied Gases, Collection I 21 Mar. 1966 p 96–102 refs (See N66-36606 22-12) CFSTI: HC $7.00/MF $1.75

This work shows that, in satisfying certain conditions, among all possible solutions of the integro-differential equations, it is possible to separate a class of solutions which also serve simultaneously as solutions of integral equations of the kinetic theory of gases. Consideration is given to two problems: the flow of a mixture of gases occupying the entire space, and the flow around a certain body by a mixture of gases. R.N.A.

N66-36614# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.

SHOCK TRANSFORMANTS OF KINETIC EQUATION OF AERODYNAMICS OF RAREFIED GASES

R. G. Barantsev *In its* Aerodyn. of Rarefied Gases, Collection I 21 Mar. 1966 p 105–119 refs (See N66-36606 22-12) CFSTI: HC $7.00/MF $1.75

Expressions are obtained for the internal and boundary transformants for the most widely used presentations on the character of the interaction and results are shown which are a direct result of substituting the obtained transformants in the kinetic equation. The effect of the conservation laws gives to the transformant T an absolutely definite form which is general for all collisions involving the conservation of the number of particles. During elastic collisions and central forces, the internal transformant is reduced to a distribution function of the particles over their angles of deflection ϑ during the scattering in the central field. The form of this function $T_\omega(\vartheta)$ is determined by the potential of the interaction U(r). Five models of U(r) are considered and the dependences $\sigma(v_0)$, $\vartheta(s)$, and $T_\omega(\vartheta)$ are shown, where v_0 is the relative velocity before collision, σ is the collision cross section, and s is the impact parameter. After substituting the transformant T' in the internal generating function $\Phi(u)$, it turns out that during elastic collisions and central forces, it coincides with the integral of inverse collisions of the Boltzmann equation. The boundary transformant is written for the specular and diffuse cases of particle reflections from the boundary. R.N.A.

N66-36615# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.

KINETIC EQUATIONS AND SHOCK TRANSFORMANTS FOR GASES WITH CLASSICAL ROTATIONAL DEGREES OF FREEDOM

I. N. Kal'nin *In its* Aerodyn. of Rarefied Gases, Collection I 21 Mar. 1966 p 120–137 refs (See N66-36606 22-12) CFSTI: HC $7.00/MF $1.75

Consideration is given to the modification of the kinetic equations for gases with classical rotational degrees of freedom, the construction of the functions σ and T for a dumbbell model, and the construction of the function T for methods of specular and diffuse reflections. R.N.A.

N66-36616# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.

REFLECTION OF MOLECULES OF GAS FROM ROUGH SURFACES

R. G. Barantsev *In its* Aerodyn. of Rarefied Gases, Collection I 21 Mar. 1966 p 138–193 refs (See N66-36606 22-12) CFSTI: HC $7.00/MF $1.75

This work investigates the influence of statistical roughness on the laws of reflection of structureless molecules from surfaces. A general formulation of the problem is given and its solution is found for an isotropic differentiable random surface. In a case of a normally moderate rough surface, it obtained a simple approximate expression for the boundary transformant. In the same approximation are calculated the impulse and the energy, transferred to the surfaces, and the aerodynamic coefficients for very simple objects in a free-molecular flow during specular and diffuse reflections on a small scale. Author

N66-36619# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.

FLOW AROUND OBJECTS BY A STRONGLY RAREFIED MONATOMIC GAS

R. G. Barantsev and Ye. V. Alekseyeva *In its* Aerodyn. of Rarefied Gases, Collection I 21 Mar. 1966 p 239–254 refs (See N66-36606 22-12) CFSTI: HC $7.00/MF $1.75

A method of iterations is expounded for the solution of an integral equation on aerodynamics of rarefied gases. Two approximations are found for a perturbed incident flow. The first turns out tto be an improved scheme of free molecular flow. The second takes into account the interaction of reflected and incident flows. Author

N66-36620# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.

FLOW AROUND SPECULARLY REFLECTING SPHERE BY STRONGLY RAREFIED GAS

Ye. V. Alekseyeva and R. G. Barantsev *In its* Aerodyn. of Rarefied Gases, Collection I 21 Mar. 1966 p 255–272 refs (See N66-36606 22-12) CFSTI: HC $7.00/MF $1.75

Consideration is given to a model problem of flow around a specularly reflecting sphere by a strongly rarefied gas consisting of a smooth elastic sphere moving at infinity with a single velocity. The method of successive approximations is applied to the solution of the integral kinetic equation. A second approximation is constructed for the distribution function f on the axis of symmetry. Calculations are then made for the distribution of density and velocity on the axis of symmetry, and also for the pressure at the tip of the sphere with Knudsen numbers K=4, 2, 1, and 1/5. Author

N66-36621# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.

RESISTANCE OF RHOMBIC PROFILE IN AN ALMOST FREE-MOLECULAR FLOW

G. Pfau, R. G. Barantsev, and Ye. V. Alekseyeva, ed. *In its* Aerodyn. of Rarefied Gases, Collection I 21 Mar. 1966 p 273–281 refs (See N66-36606 22-12) CFSTI: HC $7.00/MF $1.75

The coefficient of resistance C_x is calculated for a thin diamond shaped profile in a flow of a strongly rarefield gas at $M=\infty$. The colecules are smooth elastic spheres and the reflection from the surface is specular. The drag coefficient is calculated as a function of the Knudsen number (l=0.5, 1, and 2) using the second approximation for the function of distribution f which serves as the solution of the integral kinetic equation. Author

N66-36622# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.

APPROXIMATE DETERMINATION OF THE GAS PARAMETERS WITHIN A SHOCK WAVE

A. V. Belova *In its* Aerodyn. of Rarefield Gases, Collection I 21 Mar. 1966 p 282–297 refs (See N66-36606 22-12) CFSTI: HC $7.00/MF $1.75

Consideration is given to the problem regarding the structure of a shock wave without using assumptions about the form of the distribution function. The method of successive approximations is applied to the solution of the problem and

is constructed in the second approximation. The problem concerns a shock wave in a steady flow of a monatomic gas, the macroscopic velocity of which is directed along axis x. The velocity of macroscopic motion, the density, and the temperature of the flow; v_1, p_1, and T_1 at $x=-\infty$; are given. The corresponding quantities v_2, p_2, and T_2 beyond the shock wave ($x=+\infty$) are determined from the law of conservation of mass, momentum, and energy. R.N.A.

N66-36623# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.

THE STRUCTURE OF A SHOCK WAVE OF MAXIMUM INTENSITY IN A MONATOMIC GAS

R. G. Barantsev *In its* Aerodyn. of Rarefied Gases, Collection I 21 Mar. 1966 p 298–309 refs (See N66-36606 22-12) CFSTI: HC $7.00/MF $1.75

The profiles of density, velocity, and temperature of a shock wave of maximum intensity in a monatomic gas were calculated in the first approximation at $M=\infty$ for two collision cross sections. The results of the calculations are presented and reveal interesting qualitative properties, which will apparently remain valid even after the approach is made more precise. R.N.A.

N66-36624# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.

ABOUT ASYMPTOTIC SOLUTIONS OF KINETIC EQUATIONS

R. G. Barantsev *In its* Aerodyn. of Rarefield Gases, Collection I 21 Mar. 1966 p 310–339 refs (See N66-36606 22-12) CFSTI: HC $7.00/MF $1.75

This work considers the problem of constructing an asymptotic solution of a kinetic equation containing an arbitrary parameter near some special value of such parameter. Attention is drawn to the irregularity of asymptotic behavior over the considered parameter in the space of the remaining variables. To disclose the typical asymptotic peculiarities of kinetic problems, the asymptotic behavior of the first approximation of the distribution function $f^{(1)}=Vf^{(0)}$ and its moment in four specific examples are investigated. As a result, an idea is formed about a possible way of rigorously constructing asymptotic decompositions and about the formulation of problems for the individual stages of this method. Author

N66-36629# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.

ENERGY-MOMENTUM TENSOR OF RADIATION IN A MOVING MEDIUM UNDER CONDITIONS CLOSE TO EQUILIBRIUM

V. S. Imshennik and Yu. I. Morozov *In its* J. of Appl. Mech. and Tech. Phys. 16 Feb. 1966 p 1–15 refs (See N66-36628 22-23) CFSTI: HC $7.00/MF $1.75

For the transfer of radiation, equations of radiation hydrodynamics are derived for the energy-momentum tensor of radiation in a moving medium under conditions close to equilibrium. The basic question solved consists in the formulation of relativistics of the covariant kinetic equation of the transfer of radiation while taking into account the motion in the medium. R.Li.

N66-36630# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.

THE SPEED OF WEAK WAVES IN A RADIATING GAS

V. A. Prokof'yev *In its* J. of Appl. Mech. and Tech. Phys. 16 Feb. 1966 p 16–32 refs (See N66-36628 22-23) CFSTI: HC $7.00/MF $1.75

Consideration is given to to the relativistic velocity, and the wave propagation of weak waves in a radiating gas. It is stated that relativistic effects may be noted at small macroscopic speeds of the medium when microscopic speeds of individual particles are close to the velocity of light (very high temperatures). Differences in the values of the parameters describing radiation field in a fixed and in local systems of reference will be not only in the terms having as a factor $1/c^2$ (c being the velocity of light) but also in terms containing 1/c, owing to the Doppler effect and aberration. Linearized, and frequency equations are derived; and, the internal energy of relativistic ideal gas particles expressed mathematically. Also discussed are: the large optical length of conditional adiabatic waves, waves of small optical length, and isothermal waves. R.Li.

N66-36633# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.

INTEGRAL-MOMENT METHOD OF SOLVING THE BOLTZMANN KINETIC EQUATION

M. N. Kogan *In its* J. of Appl. Mech. and Tech. Phys. 16 Feb. 1966 p 64–73 refs (See N66-36628 22-23) CFSTI: HC $7.00/MF $1.75

The motion of a rarefield gas with random Kundsen numbers is described by Boltzmann's equation for a single-atom gas in the absence of mass forces. A solution to Boltzmann's equation is reported for a nonstationary problem. It is stated in this literature survey that the distribution function is changed by some approximation function depending on some number of moments, and that by multiplying Boltzmann's equation by the corresponding combinations of velocities, the necessary number of differential equations for the moments are obtained. Since the type and number of equation depend on the selected approximations and moments, it was necessary, for each concrete case, to develop the methods of solution of the occurring complex systems of differential equations. The number of characteristics and consequently the character of the boundary problems for this system are determined by the choice of approximations, but with the integral-moment approach, it is considered that the method of solution of any problem is identical. R.Li.

N66-36634# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.

NONEQUILIBRIUM DISTRIBUTION OF ENERGY BY OSCILLATORY DEGREES OF FREEDOM ON MOLECULES DURING DISTURBANCE OF MAXWELLIAN DISTRIBUTION

A. I. Osipov and Ye. V. Stupochenko *In its* J. of Appl. Mech. and Tech. Phys. 16 Feb. 1966 p 74–80 refs (See N66-36628 22-23) CFSTI: HC $7.00/MF $1.75

Investigated is the distribution function of energy on the basis of the vibrational degree of freedom in the presence of a quasi-stationary, but not equilibrium, distribution based on translational degrees of freedom. Problems of this type are of interest in the chemistry of "hot" atoms, and also in the study of fast particle reactions. Examined is the distribution of oscillatory energy in gas, perturbed by fast particle sources. Also mentioned are perturbations of distribution functions concentrated in the region of far energies in the tail of Maxwellian functions. R.Li.

N66-36635# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.

ON THE MEASUREMENT OR PRESSURE IN A SPIN TRANSVERSE WAVE

V. V. Mitrofanov, V. A. Subbotin, and M. Ye. Topchiyan *In its* J. of Appl. Mech. and Tech. Phys. 16 Feb. 1966 p 81–87 refs (See N66-36628 22-23) CFSTI: HC $7.00/MF $1.75

Results of measurements of the pressure field in a spin wave by small piezotransducers, which give a good agreement between the measured and the calculated magnitudes, are reported. Described are the experimental equipment, calibration, and design of the transducers in which the spin de-

tonation was conducted. It is stated that in a transverse wave the maximum pressure is 170 to 180 times greater than the initial pressure of the mixture, i.e., 10 times higher than at the Chapman–Jouguet point for the detonational wave as a whole. R.Ll.

N66-36640# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.

TURBULENT PULSATIONS IN A LIQUID JET, AND ITS ATOMIZATION

G. P. Skrebkov *In its* J. of Appl. Mech. and Tech. Phys. 16 Feb. 1966 p 142–151 refs (See N66-36628 22-23) CFSTI: HC $7.00/MF $1.75

To study the influence of transverse pulsational speeds on atomization, measurements were made of the cone angle of the atomization, exhaust velocity, and loss of pressure head along the nozzle with different degrees of roughness of its walls. On the basis of the pressure head losses, the coefficient of hydraulic friction was calculated. Corresponding to the results of preliminary experiments cited in literature, a formula is presented which shows that the fineness of the atomization must increase with an increase of degree of flow turbulence, decrease of viscosity, increase of escape velocity, and also on what dimension of the moles predominates. R. Ll.

N66-36655# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.

DETERMINING THE SHAPE OF A GAS BUBBLE IN AN AXIALLY SYMMETRIC FLUID FLOW

O. M. Kiselev *In its* J. of Appl. Mech. and Tech. Phys. 16 Feb. 1966 p 293–297 refs (See N66-36628 22-23) CFSTI: HC $7.00/MF $1.75

An approximation method for determining the shape of a gas bubble in an axially symmetric potential flow of an incompressible fluid is reported. It is shown that the shape desired differs little from an oblate ellipsoid of revolution. Equations are derived for the basic bubble dimensions according to the physical parameters of the flow. R.Ll.

N66-36656# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.

ON THE RESISTANCE OF A FLAT PLATE PERPENDICULAR TO A HYPERSONIC FLOW OF A RAREFIED GAS

O. G. Fridlender *In its* J. of Appl. Mech. and Tech. Phys. 16 Feb. 1966 p 298–304 refs (See N66-36628 22-23) CFSTI: HC $7.00/MF $1.75

Consideration is given to the aerodynamic properties of plates having one characteristic linear dimension in an almost free-molecule flow (Knudsen number $K \geq 1$) at high speeds (Mach number $M \geq 1$). The formula for the distribution of pressure along flat plates of arbitrary form is obtained in the form of a simple integral; and, for round and polygonal plates, in explicit form. By numerical integration the value C_x for a round plate is found. Using assumptions proposed in previous works, a calculation was devised of primary collisions of reflected and incident molecules in almost free-molecule flows. R.Ll.

N66-36657# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.

ON THE INTERACTION OF PERTURBATIONS WITH SHOCK WAVE IN A ONE-DIMENSIONAL TRANSIENT MOTION OF GAS

Zh. S. Sislyan *In its* J. of Appl. Mech. and Tech. Phys 16 Feb. 1966 p 305–309 refs (See N66-36628 22-23) CFSTI: HC $7.00/MF $1.75

The one-dimensional transient flow of gas caused by the motion of a piston moving in a long cylindrical tube with variable speed is discussed. It is stated that by virtue of the smallness of slight reflection at an approximate determination of the flow field between piston and shock wave, it is possible to ignore the influence of the reflected perturbations. In this approximation method, the flow behind a curvilinear compression wave is assumed approximately a simple wave (Riemann wave) in which entropy and one of the characteristics parameters have constant values equal to their values at an initial point of the piston path. A generalization of this method considering the variability of entropy in flow and its vorticity after curvilinear shock wave in a one-dimensional transient motion is indicated. R. Ll.

N66-36718# Deutsche Versuchsanstalt fur Luft- und Raumfahrt. Saarbruecken (West Germany). Wissenschaftlicher Beirat.

THEORY OF A PLANE SUBSONIC FLOW PAST AN OSCILLATING STAGGERED CASCADE. PART I: SOLUTION OF THE PROBLEM IN THE IMAGE PLANE [ZUR THEORIE DER EBENEN UNTERSCHALLSTROEMUNG DURCH EIN SCHWINGENDES, GESTAFFELES GITTER. TEIL I: LOESUNG DES PROBLEMS IN DER BILDEBENE]

Erhard Meister (Saarland Univ.) Mar. 1966 82 p refs In GERMAN; ENGLISH summary

(DLR-FB-66-12; DVL-454) CFSTI: HC $3.00/MF $0.75

It is assumed that an inviscid, barotropic gas flows with a subsonic velocity through a cascade the profiles of which being thin, slightly cambered and oscillating independently of each other with small amplitudes. The arising mixed linear boundary value problem is reduced to one for the Helmholtz equation. After separating those terms of the Fourier expansion of the reduced velocity potential that do not attenuate far before the cascade the Laplace transformation is applied leading to a functional equation in the image plane. By means of the Weiner–Hopf technique this functional equation is reduced to a linear system of infinitely many unknowns. Author

N66-36834# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.

THE EXPERIMENTAL AND ANALYTICAL DETERMINATION OF FLOW CHARACTERISTICS OF PNEUMATIC RESISTANCES

Lech. M. Kaminski 23 May 1966 17 p Transl. into ENGLISH from Archives of Automation and Telemechanics (Warsaw), v. 8, no. 3, 1963 p 335–346

(FTD-TT-65-1758; TT-66-61794; AD-635835) CFSTI: HC $1.00/MF $0.50

The paper presents an experimental and analytical method of determining the set of curves, representing flow characteristics of pneumatic resistances. The flow characteristics determined by means of this method give the relationship between the intensity of air flow and the pressure drop and the resistance over the full range of pressures encountered in pneumatic control devices. Analysis of various formulas and laboratory measurements lead to the conclusion that the most convenient formula for the pneumatic resistors is the equation for quantity of flow in long pipes. The formula is obtained on the assumption that friction is not neglected and so it gives a very good approximation of experimental results. Using this formula, it is often possible to obtain all the curves of the flow characteristic from one measurement of flow quantity under particular conditions. Dimensionless coordinates, which are used here, provide a considerable simplification of analysis because, one universal characteristic is obtained for all resistances. Flow characteristics depend not only upon the diameter and length of the throttling resistance but also surface roughness, the inlet and outlet, etc. In some cases, therefore, special corrective factors must be introduced into the universal characteristics. Author (TAB)

N66-36847*# Cornell Aeronautical Lab., Inc., Buffalo, N. Y.
AN ANALYTICAL STUDY OF SEPARATED FLOWS INDUCED BY SHOCK WAVE–BOUNDARY LAYER INTERACTION
M. S. Holden Washington, NASA, Oct. 1966 70 p refs
(Contract NAS5-3976)
(NASA-CR-600) CFSTI: HC $2.50/MF $0.75 CSCL 20D

The report presents an analysis of laminar regions of shock wave-boundary layer interaction in highly cooled supersonic and hypersonic flows. In this analysis the integral forms of the boundary layer equations are used to describe the development of the viscous layer and its interaction with the outer inviscid flow. The boundary layer equations governing conservation of mass, momentum, moment of momentum, and energy are solved simultaneously by numerical integration to yield a continuous solution over the entire interaction. The parameters required to define the properties of a specific interaction are the wall-to-stagnation temperature ratio, the Mach number of the free stream, the free-stream Reynolds number based on the length of the flat plate or the distance of shock impingement, and the Mach number downstream of the interaction (as defined by inviscid flow considerations). This method enables the detailed distribution of pressure, skin friction, and heat transfer to the walls bounding the interaction to be calculated. Further, the method describes the form and detailed development of the velocity and enthalpy profiles throughout the interaction region. Author

N66-36852*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
TRANSFER FUNCTION ANALYSIS OF A FLUID CONTAINED IN A LONGITUDINALLY EXCITED THIN-WALL CYLINDRICAL TANK
Carl F. Lorenzo Washington, NASA, Sep. 1966 24 p refs
(NASA-TN-D-3636) CFSTI: HC $1.00/MF $0.50 CSCL 20D

The transfer function for a constant-thickness, thin-wall cylindrical tank containing a fluid is derived. The fluid in the tank is assumed to have a constant ullage gas pressure and a pressure distribution initially linear with longitudinal position. The treatment is one-dimensional, and the effects of damping are considered. The transfer function developed is the response of pressure at any longitudinal position to velocity at the tank base. General expressions for the resonant and nodal frequencies are given, and the time response to a sinusoidal driving velocity for an undamped liquid is derived. A numerical example which shows the general form of the transfer function solution is given and a typical liquid-oxygen tank is analyzed. Author

N66-36859*# General Applied Science Labs., Inc., Westbury, N. Y.
NUMERICAL FLOW FIELD PREDICTION FOR PROJECT RAM-C
G. Widhopf, B. Kaplan, and J. Jannone 30 Jun. 1966 170 p refs
(Contract NAS1-5519)
(NASA-CR-66109; GASL-TR-605) CFSTI: HC $3.25/MF $1.00 CSCL 20D

Detailed flow field calculations were performed in order to investigate the state of the gas in the shock layer surrounding the vehicle. Calculations were performed at altitudes of 36.8, 53.5, and 71 km. For numerical purposes the shock layer flow field was separated into an inviscid and viscous layer wherein the viscous–inviscid interaction was taken into account by a displacement thickness iteration procedure. A nonsimilar boundary layer approach was assumed to be applicable in the viscous region where edge conditions were computed by tracing nonequilibrium inviscid streamlines as they were entrained by the boundary layer. Finite rate chemistry was computed throughout the entire shock layer. Detailed plots of profiles of velocity, temperature, electron density, pressure, and species mole fractions are presented at various surface locations. The results indicate that this type of computational procedure is not valid for this configuration at the two higher altitudes. Author

N66-36867# !IT Research Inst., Chicago, Ill.
TURBULENT FLOW TRANSITION NEAR SOLID AND FLEXIBLE BOUNDARIES Final Technical Report
Henry B. Karplus Feb. 1966 56 p refs
(Contract NONR-3682(00))
(IITRI-M-6110; AD-635582) CFSTI: HC $3.00/MF $0.50

Transition to turbulent flow was studied in a channel in which the walls could be interchanged so that both solid and flexible walls could be investigated. The flow fluctuations were measured with a hot film anemometer. Intermittency of the fluctuations was used as a criterion of the transition condition. Turbulence spectra were measured in the transition region and in the region where continuous turbulence had been established near the walls of the channel but did not extend all the way across. Turbulence spectra fall on a uniform curve when the relative band level was plotted against Strouhal number. Band spectrum levels rise from very low Strouhal numbers and fall approximately as s to the −2.5th power for high Strouhal numbers. The intermittency is a useful factor for describing flow transition. The intermittency factor increases fairly rapidly near the wall at a distance from the channel entrance governed by the flow velocity and the wall compliance. The intermittency factor increases as the wall is approached until the sublayer is reached. Flow fluctuations are amplified near walls. Solid walls produce the largest amplification. When amplitudes increase beyond a finite limit, random fluctuation characteristics of turbulence are encountered. Author (TAB)

N66-36897# Mississippi State Univ., State College. Dept. of Aerophysics.
STATISTICAL THEORY OF TURBULENCE
Yutaka Shigemitsu Jun. 1966 251 p refs *Its* Aerophys. Res. Rept.-64
(Contract DA-44-117-AMC-892(T))
(USAAVLABS-TR-66-25; AD-635654) CFSTI: HC $6.00/MF $1.25

The purpose of this report is to discuss the system of a statistical theory of turbulence in general cases from isotropic turbulence to turbulent boundary layer. In the first three chapters, mathematical formulations are given to the Euler correlation or the Reynolds stress, according to a basic physical picture of vortex chaos motion in which many kinds of vortices are carried along the flow in agitating situations. When the formula is combined with the Reynolds equations, quantitative discussions are developed by dividing the cases into two fundamental groups of wake or jet flow in chapters four through seven and of boundary layer or pipe flow in chapters eight and nine. Author (TAB)

N66-36916# Naval Weapons Lab., Dahlgren, Va.
ROTATING FLOWS OVER A ROTATING DISK FOR A CLASS OF NON-NEWTONIAN FLUIDS
Hans J. Lugt and Ernst W. Schwiderski May 1966 28 p refs
(NWL-2037; AD-636102) CFSTI: HC $2.00/MF $0.50

Axisymmetric rotating flows over a rotating disk for non-Newtonian fluids of Rainer-Rivlin type are calculated by means of an adjustable local boundary layer approximating. Variation of the dynamic similarity parameter, which characterizes the non-Newtonian fluid, shows that secondary motions of

stagnation, wake or cell type can exist. The beginning of instability in Bodewadt type motions, which indicates laminar flow separation from the surface of the disk, is shifted to higher Reynolds numbers for non-Newtonian fluids. Furthermore, the largest tangential shear stress at the surface is exhibited by laminar flows of Newtonian fluids. Author (TAB)

N66-36918# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
JOURNAL OF ENGINEERING PHYSICS Selected Articles
12 Jan. 1966 25 p refs Transl. into ENGLISH from Izhenerno-Fiz. Zh. (Minsk), v. 7, no. 10, 1964 p 14–20, 28–36
(FTD-MT-65-185; AD-634807) CFSTI: HC $1.00/MF $0.50

CONTENTS:

1. CALCULATION OF THE MAIN PORTION OF AN AXIALLY SYMMETRIC TURBULENT STREAM OF A REAL GAS V. I. Bakulev p 1–9 refs (See N66-36920 22-12)

2. FLAME PROPAGATION IN LAMINAR AND TURBULENT FLOWS A. P. Kovalev, A. S. Ippolitov, Yu. M. Torgonenko, D. Bkhaduri, N. I. Chelnokov et al p 10–20 refs (See N66-36921 22-33)

N66-36920# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
CALCULATION OF THE MAIN PORTION OF AN AXIALLY SYMMETRIC TURBULENT STREAM OF A REAL GAS
V. I. Bakulev *In its* J. of Eng. Phys. 12 Jan. 1966 p 1–9 refs (See N66-36919 22-12) CFSTI: HC $1.00/MF $0.50

An approximate solution is derived for the problem of the boundary layer of a stream of real gas on the basis of the Prandtl theory of free turbulence. An addition to the Prandtl theory has the mixing length for vector quantities less than that for scalar quantities by a factor of turbulent Pr number. The problem is solved both for a submerged stream, and also for a stream in a concurrent flow. The equation of state of a real gas is used in the solution. In the case of a stream of real gas flowing from a turbulent point source into a concurrent flow, the velocity and enthalpy profiles are calculated. Graphs are given for a submerged stream of carbon dioxide showing profiles of specific volume and velocity for three cross sections, and the values of relative velocity and enthalpy along the axis of the stream. E.A.O.

N66-36931 Massachusetts Inst. of Tech., Cambridge. Aerophysics Lab.
LAMINAR MIXING OF TWO STREAMS IN A PRESSURE GRADIENT
Robert A. Greenberg Feb. 1966 158 p refs *Its* Tech Rept.-117
(Contract AF 49(638)-1621; Grants AF-AFOSR-62-407, AF-AFOSR-641-64)
(AFOSR-66-0580; AD-633950) CFSTI: HC $5.00/MF $1.00

An analytical study was made of the laminar mixing between a gas stream ejected from the nose of a body and a shocked free stream. The physical problem was broken down into three regions of flow, one involving free mixing in the vicinity of the stagnation point, another in which the mixing layer interacts with the body surface, and a third in which viscous effects have diffused throughout the ejected flow. Only the first region was treated in detail. An approximate analytic method was developed to solve the mixing layer flow. The method allows nonsimilar mixing, variable fluid properties, and coupling between the governing equations. A comparison between results of this approximate method and exact numerical solutions for both similar and nonsimilar flows indicates very good agreement. The results for the velocity, shear, enthalpy, and enthalpy gradient at the point where the stream function is zero differ by about 3% in most cases, by 10% in the worst cases. The approximate method also predicts the variation of the flow quantities across the mixing layer very accurately. TAB

N66-36935*# Martin Co., Denver, Colo.
LIQUID SETTLING IN LARGE TANKS
T. E. Bowman [1965] 20 p refs Presented at Symp. on Fluid Mech. and Heat Transfer Under Low Gravitational Conditions, Palo Alto, Calif., 24–25 Jun. 1965
(Contract NAS8-11328)
(NASA-CR-78064; AD-633766) CFSTI: HC $1.00/MF $0.50 CSCL 20D

The results discussed showed that primary aspects of the settling flow can be validly scaled by using bond number. At least within the range covered by the investigation. Liquid level in the test vessel was not found to have an effect on the initial settling flow. Secondary flow characteristics such as viscous effects are not scaled by the bond number. The physical explanation of the fact that bond number was found to describe primary aspects of the settling flow for a wide range of vessel sizes, acceleration levels, and test liquids rests on the discussion of Taylor instabilities. Basic characteristics of the settling flow observed in the experiments are in general the same characteristics that were predicted on the basis of the Taylor instability. Within this general class of flows, differences between various specific types of flow were shown by the experiments to depend on initial conditions at the interface. Since the interface is essentially static immediately following capsule release (or application of ullaging thrust, in the full-scale case), the conditions on which the initial flow behavior is based are determined by the ratio of inertial to surface tension forces, or Bond number. Thus the basic characteristics of the entire flow should depend on the initial Bond number, as was found experimentally. Author (TAB)

N66-36945# New York Univ., N. Y. Dept. of Meteorology and Oceanography.
STEADY STATE INTERACTIONS AMONG INTERSECTING TRAINS OF CAPILLARY-GRAVITY WAVES
James B. Sullivan Jun. 1966 26 p refs
(Contract Nonr-285(57))
(TR-66-7; AD-635932) CFSTI: HC $1.00/MF $0.50

Steady state solutions are obtained by a classical perturbation procedure for the problem of intersecting trains of capillary–gravity waves. Valid to second order in the wave slope, these solutions demonstrate the possibility of wave interactions that do not exhibit an energy flux among the various wave components. Author (TAB)

N66-36955# California Univ., Livermore. Lawrence Radiation Lab.
A GENERAL THEORY FOR THE NUMERICAL SOLUTION OF THE EQUATIONS OF HYDRODYNAMICS
William F. Noh 6 May 1966 35 p refs
(Contract W-7405-ENG-48)
(UCRL-14912-T) CFSTI: HC $2.00/MF $0.50

A numerical procedure is presented (which is adaptable to most difference methods) in which the difference equations which the difference equations which are valid in the neighborhood of the contact discontinuity and which are completely consistent with the difference equations used away from the contact surface are derived. In addition, the method determines the position of the contact by explicitly invoking the conditions of continuity of pressure and continuity of the normal component of velocity. Author (NSA)

N66-37033*# National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.

VELOCITY PROFILES AND EDDY VISCOSITY DISTRIBUTIONS DOWNSTREAM OF A MACH 2.22 NOZZLE EXHAUSTING TO QUIESCENT AIR

James M. Eggers Washington, NASA, Sep. 1966 93 p refs
(NASA-TN-D-3601) CFSTI: HC $2.50/MF $0.75 CSCL 20D

An analytical and experimental study of compressible, turbulent, axisymmetric mixing was performed in order to validate or disprove recent formulations for the eddy viscosity function and to determine whether or not direct experimental determination of eddy viscosity distributions is feasible. The experimental study involved a Mach 2.22 axisymmetric nozzle exhausting to the atmosphere and operating at the design pressure ratio, with jet total temperature equal to ambient temperature. Total-pressure surveys were made across the jet at various axial stations from the nozzle exit plane downstream to 150 nozzle radii. The total-pressure surveys were reduced to velocity profiles and then, through the use of the momentum equation, to eddy viscosity distributions. It was concluded that recent modifications of the eddy viscosity functions by incorporating of a density are unwarranted for the supersonic jet in quiescent air. It was also concluded, from inspection of the eddy viscosity distributions computed from the present experimental data, that the assumption of an eddy viscosity independent of the radial coordinate is not justified. Finally, general computational difficulties were found to make an experimental determination of the eddy viscosity coefficient subject to large uncertainties and possible errors. Author (TAB)

N66-37108# Stanford Univ., Calif. Dept. of Aeronautics and Astronautics.

INTERFACIAL INSTABILITY OF LIQUID LAYERS ON ELASTIC SURFACES

Robert Dan Smith Mar. 1966 178 p refs
(Contract DA-31-124-ARO(D)-223)
(SUDAAR-259; AD-635632) CFSTI: HC $5.00/MF $1.00

The stability criteria associated with representations, of liquid layers which are in contact with flexible surfaces, are investigated theoretically by means of a linear vibration analysis. Such representations serve as mathematical models for situations involving the consideration of the stability of either a liquid stored in the elastic container of a space vehicle operating under low gravity conditions, or of the liquid phase of a material which is undergoing ablation from a flexible heat shield. The representation of the liquid layer consists of an incompressible, inviscid fluid which is subjected to a net unidirectional body force of constant intensity G and which is stored in a two-dimensional channel having a flexible floor. Irrotational flow is assumed and the cross section of the channel is restricted to the cases of a rectangle and the sector of an annulus. The equilibrium liquid-gas interface, in which the effect of surface tension is taken into account, is assumed flat for the rectangular case and to constitute a portion of a circular cylinder in the annular case. In the rectangular case the flexible floor is characterized as a uniform thin flat plate with zero in-plane edge restraint. TAB

N66-37150*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.

STABILITY OF INTERMIXING OF HIGH-VELOCITY VAPOR WITH ITS SUBCOOLED LIQUID CONCURRENT STREAMS

William H. Westendorf and William F. Brown Washington, NASA, Oct. 1966 25 p refs
(NASA-TN-D-3553) CFSTI: HC $1.00/MF $0.50 CSCL 20D

The instabilities that occur with the intermixing of a vapor with its subcooled liquid were studied with steam and water flowing horizontally through a 1-inch-diameter tube near atmospheric pressure. Oscillographic traces of pressures, temperatures, and flow rates together with high-speed movies and photographs recorded the disturbances. Three modes of instability were found: (1) random high-frequency fluctuations; (2) regular low-frequency oscillations; and (3) interface excursions. The amplitude of the fluctuations was directly proportional to the coolant inlet subcooling and flow rate. Data plots of the coolant inlet temperature as a function of the mass flow rate ratio define the regions of regular oscillatory instability and interface excursions. The amplitude of the oscillations was inversely proportional to the flow rate ratio. The similarities between these instabilities and those of subcooled boiling are examined. Author

N66-37182# California Univ., La Jolla. Scripps Institution of Oceanography.

THEORETICAL AND EXPERIMENTAL STUDY OF WAVE ENHANCEMENT AND RUNUP ON UNIFORMLY SLOPING IMPERMEABLE BEACHES Final Report

William G. Van Dorn 31 May 1966 110 p refs
(Contract Nonr-2216(16))
(SIO-66-11; AD-636225) CFSTI: HC $4.00/MF $1.75

The shoaling enhancement of small-amplitude, dispersive wave trains traveling over uniform, impermeable slopes was observed in a specially-constructed wave channel, where the reproducible wave elevation-measurement accuracy was about .0005-in. These observations substantially support the enhancement predicted from linear theory (conservation of energy flux) except in very shallow water and on very steep slopes, where accelerative effects become important. On the hypothesis that small-amplitude runup theory might be similarly valid for periodic waves of finite height, provided that the positive incident wave amplitude is replaced by the local crest height above still water, this theory was modified to include the effect of the superelevation under a wave crest due to profile asymmetry. The modified theory is shown to agree acceptably with runup observations of larger waves previously reported-both for breaking and non-breaking waves. Because solutions to the modified theory cannot conveniently be obtained by manual calculation, a nomograph chart is included, from which runup predictions can be easily made, given only the wave height, period, and water depth a wave-length or so from shore, and the beach slope. Use of this nomograph for non-uniform slopes, oblique incidence, and non-periodic waves is also discussed. Author (TAB)

N66-37184# Colorado State Univ., Fort Collins. Fluid Dynamics and Diffusion Lab.

TURBULENT DIFFUSION IN A SIMULATED VEGETATIVE COVER

Motoaki Yano May 1966 166 p refs
(Grant DA-AMC-28-043-65-G20)
(CER66MY25; AD-635919) CFSTI: HC $5.00/MF $1.00

The study of the turbulent diffusion over a rough surface in the wind tunnel was utilized with the concept of momentum defect super-position in the wakes of an array of roughness elements. Based on this concept, the characteristics of each factor of turbulent diffusion are analyzed and the results are confirmed experimentally. From agreement between theory and experiment, the concept, the turbulent shear flow consists of the combination of the individual wake flows, is confirmed. Author (TAB)

N66-37198# Mechanical Technology, Inc., Latham, N. Y.
THE DYNAMIC RESPONSE OF PERIODICALLY DEFORMED NON-NEWTONIAN FLUID FILMS
C. Wachmann, D. E. Dougherty, and C. H. T. Pan May 1966 35 p refs
(Contract Nonr-3731(00))
(MTI-66TR8; AD-636167) CFSTI: HC $2.00/MF $0.50

Analysis has shown that a time average super-or sub-ambient pressure is generated in a plane parallel squeeze film of a Maxwell fluid with shear dependent viscosity when subjected to skew periodic transverse deformation. The flow behavior index of the fluid, which indicates the deviation from the Newtonian regime, and the ratio of the period of the compression stroke to the total period determine whether the net pressure is superambient or subambient. Fluid consistency, and plate geometry and stroke affect the magnitude of the pressure values. The elastic properties of the fluid enter only into transient response terms and do not contribute to the net pressure. These effects are not obtained for Newtonian fluids or if the deformation is symmetric. Examples are given. Author (TAB)

N66-37232# Michigan Univ., Ann Arbor.
INFLUENCE OF FLOW AND ROTATIONAL OSCILLATIONS ON THE MECHANICS OF TWO-DIMENSIONAL LAMINAR BOUNDARY-LAYER FLOW PAST CYLINDERS, INCLUDING UNIFORM SUCTION OR BLOWING Final Scientific Report
Wen-Jei Yang and John A. Clark Wright-Patterson AFB, Ohio, ARL, Jan. 1966 103 p refs
(Contract AF 33(657)-8368)
(ARL-66-0010, Pt. 5; AD-635706) CFSTI: HC $4.00/MF $0.75

A theoretical investigation of the influence of flow oscillation, fluctuating circulation and rotational oscillation upon the transfer of momentum, heat and mass in two-dimensional laminar boundary-layer flow past cylinders with or without uniform suction. The boundary-layer equations for flow, temperature and concentration are linearized by means of a perturbation procedure and the first three terms retained. The solutions of the velocity, temperature and concentration components are obtained in the forms of an ordinary blasius series for a symmetrical blunt body and a generalized blasius series for a sharp-edged body. Theoretical results include the frequency response of fluid velocity, temperature and concentration, the streamline patterns of the streaming, the distribution of the steady second-order temperature and concentration, and the alternations in the shear stress, rates of heat and mass transfer. For flow around a circular cylinder numerical results show that the permanent alterations in the skin friction and heat transfer rate induced by the flow oscillation, fluctuating circulation and rotational oscillation are very small in the range of small amplitude and low frequency. Author

N66-37243# California Univ., Berkeley. Coll. of Engineering.
MEASUREMENTS OF PRESSURES ON A HEAVING PROLATE SPHEROID
Choung Mook Lee and John R. Paulling Mar. 1966 44 p refs
(Contract Nonr-222(43))
(NA-66-4; AD-635927) CFSTI: HC $2.00/MF $0.50

The damping and added mass coefficients for a shiplike form oscillating at a free surface are usually approximated by a strip calculation in which two-dimensional values for shapes similar to sections of the body are summed over the length. For the three-dimensional body the real section values differ from the local values used in this procedure because of the three-dimensional nature of the real flow caused by body geometry and forward speed. This report presents experimental results which show the magnitude of the three-dimensional effect for a prolate spheroid undergoing forced heaving oscillations while moving longitudinally in calm water. Local hydrodynamic forces on a spheroid model were measured by a number of flush pressure gauges distributed around the girth of the model at several sections. The sectional added mass and damping were than obtained by resolving the integral of pressure at each section into in phase and quadrature components. Total constraint forces were measured and checked against the longitudinally integrated pressure forces. Results were compared with strip computations using two-dimensional cylinder data. In general, the greatest discrepancies were found at the ends of the model. At amidships, measured values agreed quite closely with two-dimensional results. At high frequencies, forward speed was found to have small effect on added mass. However, at high frequencies and high forward speed, negative damping was found at some sections. Author (TAB)

N66-37292*# Catholic Univ. of America, Washington, D. C.
TAYLOR INSTABILITY IN A STRATFIED FLOW
Thomas J. Eisler Washington, NASA, Oct. 1966 22 p refs
(Grant NsG-586)
(NASA-CR-569) CFSTI: HC $1.00/MF $0.50 CSCL 20D

The effect of a mean flow and density stratification of the instability of a density discontinuity is investigated. The flow is of the jet type between parallel walls with a piecewise linear velocity profile. The stratification is statically stable. The dominant instability occurs for large values of the perturbation wavenumber. The stratification and flow are generally stabilizing, but the effect of the stratification is found to be destabilizing with respect to small wavenumbers. Author

N66-37320*# Polytechnic Inst. of Brooklyn, N. Y.
ELECTRONIC EFFECTS IN EXPANSIVE FLOW UNDER HYPERSONIC CONDITIONS
Martin H. Bloom [1966] 28 p refs
(Grant NsG-409)
(NASA-CR-78199) CFSTI: HC $2.00/MF $0.50 CSCL 20D

Experiments have been conducted on plasma effects in the nozzle of a hypersonic shock tunnel employing air as the test gas, at Mach 13, a density of 7.8×10^{-5} atm and static temperatures of 140°K. Surveys of electron density have been made by S-band microwave resonance cavities of flow-through type, indicating a 20-in. diameter non-diffusive, uniform central core at a level of 6×10^{8} electrons/cc. These correlate with the extent of the neutral boundary layer as determined by heat transfer measurements. Electron temperatures of 3000°K were measured by current-probes and compared with the equilibrium supply temperature of 3900° K. On the basis of independent ion-current measurements with cylindrical probes in the range of probe diameters on the order of the Debye length, but otherwise free-molecular, the currents are seen to exceed the values of a collisionless (L-B-R) theory. The feasibility of making electron density profile surveys around bodies has been demonstrated. Finally, surface-probe ion-current distributions around a blunt body are seen to correlate with neutral density distributions. Author

N66-37398# Michigan Univ., Ann Arbor.
A FINITE DIFFERENCE METHOD FOR COMPUTING UNSTEADY, INCOMPRESSIBLE, LAMINAR BOUNDARY-LAYER FLOWS Final Scientific Report
Charles Luh-sun Farn, Vedat S. Arpaci, and John A. Clark Wright-Patterson AFB, Ohio, ARL, Jan. 1966 133 p refs
(Contract AF 33(657)-8368)
(ARL-66-0010, Pt. III; AD-636252) CFSTI: HC $4.00/MF $1.00

A finite difference method for computing velocity and temperature profiles of an unsteady, incompressible, laminar boundary layer around a two-dimensional cylinder of arbitrary cross section is developed. Blowing or suction may be present on the wall of the cylinder. The thermal boundary condition at the wall may be either specified wall temperature or specified heat flux at the wall. The governing finite difference equations are explicit, the velocity and the temperature at the next time step can be directly computed in terms of those at the current time step. Various errors associated with the finite difference method are studied. Great effort has been made to derive the stability and convergence conditions of the method. The upper bound of the local rounding errors is estimated. Two examples, one oscillation in Blasius flow and the other impulsive start of wedge flow, are given: the numerical results are compared with the existing analytical and experimental results. It is concluded that the present method can be used for the aforementioned computation with high accuracy except at and near a singular point where the singular errors become significant. Author (TAB)

N66-37414*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.

TABLES OF MACH NUMBER FROM 0 TO 100 FOR COMPRESSIBLE GASES WITH SPECIFIC HEAT RATIOS FROM 1.66 THROUGH 1.10

Daniel Dembrow Jun. 1966 141 p

(NASA-TM-X-55567; X-470-66-269) CFSTI: HC $3.00/MF $1.00 CSCL 20D

Mach numbers from 0 through 100 are tabulated for working compressible fluids other than air, considered to be perfect gases with specific heat ratios ranging from 1.66 to 1.10. The tables give useful dimensionless ratios for one-dimensional flow processes of perfect gases. The calculations were initiated in order to treat rocket exhaust compositions with high mixture ratios of hydrogen and fluorine propellants; they were later extended to include other gases. A Fortran program for an IBM 7094 computer is provided to permit calculations, comparison, and interpolation with other published tabular values for working fluids generally encountered in rocket thrust chamber and nozzle design. Author

N66-37420# Cornell Aeronautical Lab., Inc., Buffalo, N. Y.

EXACT NUMERICAL SOLUTIONS OF THE TIME-DEPENDENT COMPRESSIBLE NAVIER-STOKES EQUATIONS

John William Kurzrock (Ph.D. Thesis) Feb. 1966 196 p refs (CAL-AG-2026-W-1)

The numerical solution of the nonlinear partial differential equations describing transient, compressible, viscous, heat-conducting flow is considered. An explicit time finite-difference scheme was used to approximate the compressible Navier-Stokes equations. The resulting set of nonlinear algebraic equations was solved on the IBM 7044 digital computer. Explicit stability was studied in great detail using the von Neumann stability criteria and the analytical estimates were compared with the numerous numerical stability results obtained on the computer. Exact numerical solutions for shock tube flow and low density flow over a sharp-edged flat plate were obtained to demonstrate the numerical method as well as to increase the fundamental understanding of these complex problem areas. For simplicity, an ideal, nonreacting gas with constant specific heats and constant Prandtl number was considered. Author

N66-37427# Naval Academy, Annapolis, Md. Dept. of Engineering.

A THEORY OF CONDENSATION AND EVAPORATION OF AEROSOLS

Ernest R. Buckle (Imperial Coll., London) May 1966 65 p refs

(Rept.-1; AD-636157) CFSTI: HC $3.00/MF $0.75

The theory described represents a first attempt at devising a model of growth and decay of particles in aerosols which does not depend on the application of properties of the macroscopic condensate to clusters containing only a few molecules. Attention is confined to chemically inert binary mixtures in which one component is a monatomic vapor and the other is a monatomic permanent gas. The pricipal causes of growth and decay are unimolecular and bimolecular processes described by canonical ensemble statistics developed from the theory of homogeneous gas reactions. The cohesive force between condensing molecules is pairwise additive, isotropic and of short range, and only the energy exchanged between translations and intermolecular vibrations affects the stability of clusters. Evolution of the aerosol from a specified initial distribution of clusters is described by an expanding chain of simultaneous nonlinear rate equations in the concentrations and the time, with coefficients given by the statistics as explicit functions of temperature. These equations are not integrable, but may be solved by computer methods. Equilibrium distributions are obtained by detailed balancing, and show minima defining a cluster size at which isothermal growth is throttled. There is therefore a resemblance to the critical size effect in Volmer's theory. Author (TAB)

N66-37438# Michigan Univ., Ann Arbor. Gas Dynamics Labs.

AN AXISYMMETRIC SIMILARITY SOLUTION FOR VISCOUS TRANSONIC NOZZLE FLOW

M. Sichel and Y. K. Yin Jul. 1966 31 p refs *Its* Rept.-07146-1-T

(Contract DA-31-124-ARO(D)-276)

(AROD-3537-2; AD-636253) CFSTI: HC $2.00/MF $0.50

An axisymmetric viscous-transonic equation is presented. A nozzle type similarity solution of this equation has been found, which describes the initial stages in the development of shock-waves downstream of a converging-diverging nozzle throat. This solution is an extension of a two dimensional solution found previously (Sichel 1966). By an appropriate choice of an arbitrary scaling constant solutions were found such that there is essentially a weak normal shock near the axis with effects of wall and shock wave curvature occurring only at a sufficiently large radius. The upstream and downstream asymptotic behavior of these viscous-transonic nozzle solutions has been investigated. Author (TAB)

N66-37565*# Mississippi State Univ., State College. Engineering and Industrial Research Station.

RESEARCH STUDY FOR DETERMINATION OF LIQUID SURFACE PROFILE IN A CRYOGENIC TANK DURING GAS INJECTION Annual Report No. 2, Jun. 16, 1965-Jun. 17, 1966

William D. Mc Cain, Jr., E. H. Bishop, Richard E. Forbes, William S. Cagle, and James T. Smith 17 Jun. 1966 177 p refs

(Contract NAS8-11334)

(NASA-CR-78362) CFSTI: HC $5.00/MF $1.25 CSCL 20D

The entrainment of liquid by high velocity saturated gas streams has been investigated for selected geometries to determine the feasibility of using this method to remove liquid entrapped in undesirable locations in rocket systems. Research to determine the height and shape of surface disturbances caused by the rise of both single gas bubbles and swarms of bubbles is also reported. Results were obtained for modified U-type configurations with water as the entrapped liquid and air as the impinging gas. A single system of equations based on the single bubble theory is presented which

represents surface profile data for a wide range of inlet gas flow rates. Tables of detailed experimental data are given, and a bibliography from a literature survey in the area of liquid entrainment is included. A.G.O.

N66-37575*# Army Missile Command, Huntsville, Ala.
SOME PECULIARITIES IN THE DESIGN OF A NONEQUILIBRIUM TWO-STEP NOZZLE
V. A. Bashkatova and A. A. Tsvetkova 10 May 1966 16 p refs Transl. into ENGLISH from Izv. Sibirskogo Otd. Akad. Nauk SSSR (Novosibirsk), v. 6, no. 2, 1965 p 88–93
(Contract NAS5-9299)
(NASA-CR-78390; RSIC-545; TT-66-6L787; AD-635734) CFSTI: HC $1.00/MF $0.50 CSCL 20D

The acceleration of droplets in a gas flow, in the case in which the temperature and velocity of the droplets and the gas differ widely, is discussed. A solution of the problem is obtained by taking the thermal and mechanical interaction between the droplets and the gas into account and using an equation for the droplet dynamics in the form of an empirical quadratic law with allowance for a pressure gradient. Author (TAB)

N66-37599# Syracuse Univ. Research Inst., N. Y. Dept. of Mechanical and Aerospace Engineering.
INVESTIGATIONS OF INTERACTING JET FLOWS. PART II: A. SINGLE, TWO-DIMENSIONAL UNDEREXPANDED JET FLOWS FROM A SONIC NOZZLE. B. INTERACTION OF TRANSVERSELY IMPINGING, TWO-DIMENSIONAL JET FLOWS Final Report
William J. Sheeran and Darshan S. Dosanjh Aug. 1966 314 p refs
(Grants NSF GK-568; NSF GP-839; NSF GP-1137)
(ME-1058-6608F)

A characteristics solution for the flow field of an underexpanded, two-dimensional jet issuing from a nozzle with uniform exit conditions was developed and programmed for the IBM 7074 system. The theoretical centerplane Mach number distribution and the theoretical boundaries of the two-dimensional jets issuing from a sonic nozzle were computed from the characteristics solution for the range of operating pressure ratio from 2.547 to 36.919 and were compared with the corresponding experimental data where possible. The three distinct criteria proposed by different authors for the theoretical prediction of the Riemann wave in underexpanded, axisymmetric jet flows were examined for possible application to two-dimensional jet flows. From a comparison with experimental data, it was discovered that none of these criteria were successful in predicting the Riemann wave in two-dimensional jet flows issuing from a sonic nozzle operated at moderate pressure ratios. Discrepancies between the assumptions of these criteria and the actual experimental observations of the two-dimensional jet flows are examined. Author

13 GEOPHYSICS

Includes aeronomy; upper and lower atmosphere studies; oceanography; cartography; and geodesy. For related information see also: 20 Meteorology; 29 Space Radiation; and 30 Space Sciences.

N66-38464# Library of Congress, Washington, D. C. Aerospace Technology Div.
ELECTROMAGNETIC WAVE PROPAGATION AND THE UPPER ATMOSPHERE Survey of Soviet-bloc Scientific and Technical Literature
George Steblez 11 Jul. 1966 79 p refs Compilation of abstracts
(ATD-66-88)

This compilation of abstracts is based on Soviet open sources published 1965–1966, and is the second in a series of reports reviewing Soviet research on electromagnetic wave propagation and the upper atmosphere. The 67 abstracts are arranged alphabetically by author with each of the following categories: ionosphere and EM wave propagation; solar and cosmic radiation effects on the ionosphere and the geomagnetic field; effects of upper atmosphere on ELF, VLF, LF, MF, and HF propagation; telluric currents, geomagnetism and whistlers; effects of nuclear bursts on EM wave propagation; satellite and missile EM wave propagation effects; aurora and EM wave propagation; and over-the-horizon propagation phenomena. Author

N66-38502# Weapons Research Establishment, Salisbury (Australia).
IONOSPHERIC DATA FOR DECEMBER 1965 FROM SALISBURY, SOUTH AUSTRALIA
May 1966 25 p
(WRE-CPD-1965/12(5)) CFSTI: HC $1.00/MF $0.50

Tables of the hourly values of ionospheric parameters are presented for a station at Salisbury, South Australia for December 1965. S.C.W.

N66-38503# Weapons Research Establishment, Salisbury (Australia).
IONOSPHERIC DATA FOR NOVEMBER 1965 FROM WOOMERA, SOUTH AUSTRALIA
Jun. 1966 26 p
(WRE-CPD-1965/11(W)) CFSTI: HC $2.00/MF $0.50

Tables of the hourly values of ionospheric parameters are presented for a station at Woomera, South Australia for November 1965. S.C.W.

N66-38512# Kansas Univ., Lawrence.
USE OF ORBITAL RADARS FOR GEOSCIENCE INVESTIGATIONS
J. W. Rouse, Jr., W. P. Waite, and R. L. Walters *In* Canaveral Council of Tech. Soc. 3d Space Congr. 1966 p 77–94 refs
(See N66-36506 22-30)
(Contract NSR-17-004-003)

The applicability of remote sensing by radar in fields related to earth sciences, agriculture, and oceanography, and space exploration is discussed. The character of radar return is examined; and techniques used to record, interpret, and extract the geoscience information content of the radar return are presented. Experiments in scatterometry conducted to define the interactions of electromagnetic waves with rough surfaces are reported. Several radar images which contain information applicable to geology, agriculture, and sea-ice studies are described. Radar altimeters are discussed with respect to their use to provide data for improved orbit calculation and reconstruction of the size and shape of the planetary or lunar body; for determining sea slope and small scale undulations of the geoid; and for defining the mass budget of the Antarctic and Greenland ice sheets. The value of radar penetration measurements for sub-surface investigation by spacecraft in lunar orbit altitudes is mentioned. S.P.

N66-36578# Toronto Univ. (Ontario).
THE RATE OF PRODUCTION OF OZONE IN THE LOWER STRATOSPHERE
A. W. Brewer *In* Mc Gill Univ. Proc. of the (6th) Stanstead Seminar on the Middle Atmosphere May 1966 p 195–198 (See N66-36566 22-20) CFSTI: HC $7.00/MF $1.75

Equations for calculating the production of ozone are briefly stated, and a calculation of a global cross section of ozone production in summer and winter is performed. The results are shown as 100 times the production on one particular day with the sun rising and setting when the solar declination was 18°N and 18°S. K.W.

N66-36579# Alberta Univ., Edmonton.
"STARFISH PRIME" CADMIUM-109 HIGH ALTITUDE TRACER EXPERIMENT
F. R. C. Ezemenari *In* Mc Gill Univ. Proc. of the (6th) Stanstead Seminar on the Middle Atmosphere May 1966 p 199–209 refs (See N66-36566 22-20) CFSTI: HC $7.00/MF $1.75

Transport and deposition over the earth of unique tracers for studying atmospheric circulation is discussed. Previously conducted experiments with W-185 and Rh-102 tracers are reviewed and their inadequacy due to the uncertainty as to amounts of debris introduced into the atmosphere, particularly from other sources, is pointed out. The subsequent selection of Cd-109, a radionuclide not normally produced in a nuclear explosion, is discussed, and its use as tracer since the "Starfish Prime" high altitude test is described. The decay scheme and the detection of Cd-109 are also discussed. Thus far experiments indicated that (1) at altitudes below 20 km, mixing between the hemispheres is slow; (2) material injected into the upper atmosphere or into space is immediately distributed uniformly throughout the upper atmosphere and returns to the stratosphere within months; and (3) there is a debris store in the atmosphere. K.W.

N66-36580# Toronto Univ. (Ontario).
THE MEASUREMENT OF SOLAR ULTRAVIOLET RADIATION IN THE STRATOSPHERE
A. W. Brewer and A. W. Wilson *In* Mc Gill Univ. Proc. of the (6th) Stanstead Seminar on the Middle Atmosphere May 1966 p 221–232 refs Sponsored in part by a Meteorol. Serv. of Can. Grant (See N66-36566 22-20) CFSTI: HC $7.00/MF $1.75

Three balloon flights were performed with attached ultraviolet sonde and meteorological sonde with ozone sensor element. Two ascents were timed that the balloon reached 15 km at 30 minutes after noon, and the ultraviolet sonde was suspended 35 m below the balloon; the third launch was timed so that the sun was overhead when the balloon was at the operating levels, and the sonde was suspended 10 m below the balloon. A platinum-surface photocell detector was used in a sonde assembly that was designed to expose the photocell toward the zenith with an acceptance angle extending to 55° from the zenith. A telemetry system transmitted the photocurrent to the ground. Measured were radiation flux, light scattering, pressure/temperature, and ozone/pressure distributions. Calculated intensity of solar radiation in the 2100 Å window was found to agree with the measurements only if adjustments were made to oxygen absorption cross section and solar intensity data. K.W.

N66-36588# Joint Publications Research Service, Washington, D. C.
THE MEASUREMENTS OF BRIGHTNESS OF THE EARTH AS A PLANET WITHIN THE WATER VAPOR ABSORPTION ψ-BAND AND TRANSPARENCY WINDOW AT 1.25 μ
V. I. Kushpil' and K. F. Khazak 15 Sep. 1966 18 p refs Transl. into ENGLISH from Fiz. Atmosfery i Okeana (Moscow), v. 2, no. 7, 1966 p 714–720
(JPRS-37650; TT-66-34078) CFSTI: $1.00

Described are the results of brightness measurements of the planet earth, from which the mass of water vapor in the atmosphere above the upper edge of the cloud cover is determined. For the region of the spectrum passed by the light filter, the corrections for pressure and temperature were not found. Another shortcoming of the experiment was the low altitude of the sun above the horizon at the moment of measurement which forced operation with bundles of great horizontal length. The masses of water vapor obtained are compared with data of serological soundings. Measuring instrumentation is briefly mentioned. The measurements which were made are considered to illustrate the possibilities of a practical solution to one of the problems of satellite meteorology. R.Li.

N66-36642# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
SIMILARITY OF COMPRESSION WAVES DURING EXPLOSIONS IN GROUNDS
B. G. Rulev *In its* J. of Appl. Mech. and Tech. Phys. 16 Feb. 1966 p 166–182 refs (See N66-36628 22-23) CFSTI: HC $7.00/MF $1.75

Experimental data obtained from investigations of earth compression waves during ground explosions are reviewed. Mentioned are the geometric similarity of the earth motion for the ejection of ground and for seismic oscillations. The essential influence of the force of gravity is noted. Seismic wave parametric measurements in fairly monotypic grounds are cited. Figures depict the characteristic recording of ground oscillations during explosions, and seismograms show that the compression wave (normal longitudinal wave) emerges almost normally to the surface, since the first entry in the horizontal component pertains to the longer period wave N. The coincidence of particle velocity values during explosions in rock and clay at remote distances is included. A comparison between recordings of the particle velocities and displacements in the initial sector shows that the velocity of the particles (and consequently of the pressure) increases up to maximum value during time τ_1, equal to several milliseconds. R.Li.

N66-36643# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
WAVES IN THE SURFACE REGION OF A GROUND HALF-SPACE DURING A CONTACT EXPLOSION
V. D. Alekseyenko *In its* J. of Appl. Mech. and Tech. Phys. 16 Feb. 1966 p 183–188 (See N66-36628 22-23) CFSTI: HC $7.00/MF $1.75

In measuring the field of stresses excited by contact explosion on the surface of soft gound, it was ascertained that the wave in the ground near the free surface has two maxims. Phenomena occurring during contact explosion were considered to establish the nature of these two stress maxima. It was concluded that the recorded maxima on oscillograms of the stresses are generated by the two fronts of longitudinal waves. Experiments showed that when half-space consists of soft ground unsaturated with water the difference in propagation speeds of the front of the air shock wave, and the front of waves in the ground is fairly large, especially at small distances from the center of explosions. Therefore, the slope angle of the fronts of the longitudinal and the transverse waves generated by the air shock wave with respect to the free surface is small. R.Li.

N66-36687# Joint Publications Research Service, Washington, D. C.

THERMAL RADIATION SOUNDING OF THE WATER SURFACE LAYER FROM RADIATION OF HEAT

Yu. M. Timofeyev 15 Sep. 1966 10 p refs Transl. into ENGLISH from Izv. Akad. Nauk SSSR, Ser. Fiz. Atmos. i Okeana (Moscow), v. 2, no. 7, 1966 p 772–774
(JPRS-37653; TT-66-34081) CFSTI: $1.00

The heat exchange process between the water surface and the atmosphere is examined because of the importance of this process in forming climate and weather. Difficulties arise when attempting to determine the temperature gradient in the thin surface water layer by normal methods, thus the possibility of using infrared spectroscopy for this determination is considered. It is stated that the problem is simplified because there are experimental and theoretical bases to consider that in the thin surface layer of water, the temperature is a linear function of the depth. Additionally, the absorption spectrum of liquid water presents no difficulty in modeling the absorption coefficient for any finite spectral interval. The factors which affect the selection of the section of the spectrum in which it is most rational to conduct measurements for determining the temperature gradient are discussed briefly. H.S.W.

N66-36904# Air Force Cambridge Research Labs., Bedford, Mass. Upper Atmosphere Physics Lab.

UPPER ATMOSPHERE RESEARCH USING AIRCRAFT
Interim Scientific Report

George J. Gassmann and Eugene W. Pittenger Apr. 1966 61 p refs *Its* Spec. Rept.-44
(AFCRL-66-292; AD-636415) CFSTI: HC $3.00/MF $0.75

An existing airborne installation is described and its potentialities are outlined. The particular properties of a jet aircraft (movability, speed, altitude) combined with appropriate ionospheric sounding equipment (receivers, optical apparatus, magnetometer, and cosmic ray recorders) constitute a unique capability. After reviewing past results obtained from more limited airborne equipment, an outline of operations and objectives is given, pertaining to: magnetic shell propagation, Arctic radio physics, eclipse effects, dumping of trapped electrons, equatorial electrojet, nuclear detonation effects, ionospheric drifts, airglow and cosmic ray surveys. Author (TAB)

N66-26944# Cornell Aeronautical Lab., Inc., Buffalo, N. Y.

1965 SOLAR ECLIPSE PARTIAL REFLECTION EXPERIMENT Final Technical Report

H. Andreas von Biel Dec. 1965 43 p refs
(Contract DA-49-146-XZ-403)
(CAL-VS-2025-P-1; AD-635622) CFSTI: HC $2.00/MF $0.50

A partial reflection experiment, conducted on Aitutaki, Cook Island, before, during and after the 1965 solar eclipse, is described. A small portion of the data collected during the expedition is presented in the form of ten electron density profiles collected between the times of 13 minutes before totality until two and one half hours after totality. Also included is a three day noon-time average electron density profile for comparison purposes. The statistics of d-region echoes are described and their implications are discussed. The general conclusion from the data is that the solar eclipse caused little, or no changes in the electron density distribution at altitudes below 75 km. The predominant eclipse effects were noticed at altitudes of 78 km and higher. The data presented also suggest that the d-region electron density recovered to near normal in a time interval of about 80 minutes after totality. Even though the data analyzed are too few to reach definite conclusions regarding the electron density history during the eclipse, the trends evident from the results are sufficiently well defined to establish the usefulness of the experimental technique for d-region investigation during a solar eclipse. Author (TAB)

N66-37006# United Kingdom Atomic Energy Authority, Harwell (England).

GLOBAL SPREAD IN THE ATMOSPHERE AND FALL-OUT OF RADIOACTIVE PRODUCTS OF NUCLEAR EXPLOSIONS

I. L. Karol and S. G. Malakov Nov. 1965 64 p refs Transl. into ENGLISH from the book "Radioaktivnye Izotopy v Atmosfere i Ikh Isopl'zovanie v Meteorologii" Moscow, Atomizdat, 1965 p 244–282
(NP-TR-1370)

The results of research on the global distribution in the atmosphere of radioactive products of nuclear explosions and on the fallout on the earth's surface are reviewed. NSA

N66-37010# United Kingdom Atomic Energy Authority, Harwell (England). Research Group.

THE PLANETARY DISTRIBUTION OF LEAD-210 IN THE FREE ATMOSPHERE AND ITS APPLICATION TO ESTIMATE THE PARAMETERS OF VERTICAL EXCHANGE AND WASH-OUT OF AEROSOLS BY CLOUDS AND PRECIPITATION, AND THE RATE OF EXCHANGE BETWEEN TROPOSPHERE AND STRATOSPHERE IN THE TWO HEMISPHERES

I. L. Karol' Nov. 1965 31 p refs Transl. into ENGLISH from the book "Radioaktivnye Izotopy V Atmosfere i Ikh Ispol' zovanie V. Meteorologii" Moscow, Atomizdat, 1965 p 132–152
(NP-TR-1389)

Preliminary results are presented for an investigation of the planetary meridonal distribution of concentration of the radioactive isotope lead-210 (RaD) with a half-life of 23 years. Aircraft measurements of the concentrations of RaD and isotopes in the atmosphere and stratosphere are tabulated, and equations are presented for the annual RaD balance in the stratosphere of the northern and southern hemispheres. These investigations are aimed at examining the influence of meteorological factors on the content of radioactive substances in the atmosphere, and the use of these substances as tracers for qualitative and quantitative investigation of meteorological processes. S.P.

N66-37062 Aeronautical Chart and Information Center, St. Louis, Mo.

USE GROUP VELOCITY OF RAYLEIGH AND LOVE SURFACE WAVES TO DETERMINE THE CRUSTAL THICKNESS IN CHINA [YUNG JUI LEI HO LO FU MIEN PO CH'UN SU TU CH'UEH TING WO KUO TI K'O HOU TU]

Chung-ho Sung and Ch'eng-yeh T'an [1965] 23 p refs Transl. into ENGLISH from Ti-ch'iu Wu Li Hsueh Pao (Peking), v. 14, no. 1, 30 Mar. 1965 p 33–44
(ACIC-TC-993; TT-66-61766; AD-635370) CFSTI: HC $4.00/MF $0.50

Translation of chinese research: the group velocity of Rayleigh and Love surface waves is used to determine the crustal thickness in China. TAB

N66-37078# Applied Physics Lab., Johns Hopkins Univ., Silver Spring, Md.

ON THE PROPAGATION OF STRONG RADIOWAVES IN THE IONOSPHERE

E. I. Ginzburg 27 Jun. 1966 15 p refs Transl. into ENGLISH from Izv. Vyssh. Ucheb. Zaved., Radiofiz. (Gor'kiy), v. 7, no. 6, 1964 p 1041–1048
(Contract NOw-62-0604-c)
(TG-230-T484; TT-66-61810; AD-635891) CFSTI: HC $1.00/MF $0.50

Propagation in the lower ionosphere of very strong radiowaves whose field strengths considerably exceed any characteristic plasma field is considered. Formulas are deduced for the change in amplitude of the field intensity as a function of penetration into the weakly ionized plasma. Author (TAB)

N66-37107# Aeronautical Chart and Information Center, St. Louis, Mo.
PROBLEM ON IRREGULAR 3-DIMENSIONAL DENSITY DISCONTINUITY SURFACES [PU KUEI TSE SAN WEI MI TU FEN CHIEH MI EN WEN T'I]
Hsu Yun Mar. 1965 20 p refs Transl. into ENGLISH from Ti Ch'IU Wu Li Hseuh Pao (Peking), v. 24, no. 1, 30 Mar. 1965 p 56–65
(ACIC-TC-992; AD-635369) CFSTI: HC $6.00/MF $0.50

Homogeneous isotropic multi-variable random function is used to describe the fluctuation of the 3-dimensional density discontinuity surface. A relationship between the gravity anomaly and the change of the discontinuity surface buried depth is derived on the basis of the statistical equivalent method. The result is used to analyze the relation of linear correlation between the crustal thickness and the local Bouguer gravity anomaly, and good agreement is obtained in comparison with the actual statistical data. Author (TAB)

N66-37123# Geological Survey, Washington, D. C.
BERYLLIUM CONTENT OF VOLCANIC ROCKS
Daniel R. Shane and Stanley Bernold Washington, GPO [1966] 81 p refs *Its* Geol. Survey Bull. 1214-C
GPO: $1.25

Spectrographic and chemical analysis of 1,172 saturated and oversaturated volcanic rocks, including tuffs, flow rocks, and glasses, bring out several possibly significant relations between the beryllium content and the content of silica, water, and fluorine. The analyses indicate that beryllium content, averaging 2.3 parts per million in all rocks, has a marked tendency to increase as silica content increases. Volcanic tuffs contain, on the average, less beryllium than do flow rocks and glasses of similar silica content, and they show a constant increase of beryllium with silica. Analyses of a few undersaturated (alkali-rich) volcanic rocks suggest that such rocks contain an anomalously high beryllium content. Beryllium has a straightforward positive correlation with fluorine in tuffs, flow rocks, and glasses. Volcanic rocks high in beryllium are especially concentrated in western Utah, southern Idaho, and northeastern Nevada. Sparse data indicate a second broad province of anomalously high beryllium contents in central Colorado, western New Mexico, western Texas, and southeastern Arizona. Author

N66-37161# Canada. Dept. of Transport, Toronto. Meteorological Branch.
CANADIAN UPPER AIR DATA MONTHLY BULLETIN, DECEMBER 1965 AND SUPPLEMENT
[1966] 149 p
(AD-486354)

Tabulated upper atmospheric data on pressure, temperature, relative humidity, and wind taken from various Canadian radiosonde stations during December of 1965 are presented. R.N.A.

N66-37178# Utah Univ., Salt Lake City. Upper Air Research Lab.
DIRECT *IN SITU* MEASUREMENTS OF AURORAL PARAMETERS Scientific Report No. 4
Kay D. Baker 6 May 1966 202 p refs
(Contract AF 19(628)-4995)
(UU-66-8; AFCRL-66-413; AD-635604) CFSTI: HC $6.00/MF $1.25

Three rockets were fired into visible auroral forms from Ft Churchill, Manitoba, Canada in the winters of 1964 and 1965. The rocket payloads contained a complex array of instruments in a program to simultaneously conduct direct in situ measurements of many important auroral parameters. The techniques and results of these measurements are presented followed by a discussion on the inter-relationships between the atmospheric ionization, heating, excitation, and auroral light emission, resulting from the energetic electron flux interacting with the atmosphere. TAB

N66-37181# Massachusetts Inst. of Tech., Cambridge. Dept. of Meteorology.
STUDIES OF THE ATMOSPHERIC GENERAL CALCULATION, V Final Report, 1 Apr. 1963–31 Mar. 1966
G. O. P. Obasi, et al 31 Mar. 1966 184 p refs
(Contract AF 19(628)-2408)
(AFCRL-66-279; AD-635546) CFSTI: HC $3.00/MF $1.00

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14. ON THE STRUCTURE AND ENERGETICS OF LARGE SCALE HYDROMAGNETIC DISTURBANCES IN THE SOLAR PHOTOSPHERE Victor P. Starr and Peter A. Gilman 7 p refs

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15. A SIDELIGHT ON LONG RANGE FORECASTING Victor P. Starr 5 p refs

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N66-37193# Lincoln Lab., Mass. Inst. of Tech., Lexington.
LASA ON-LINE DETECTION, LOCATION AND SIGNAL-TO-NOISE ENHANCEMENT
Edward J. Kelly 1 Jul. 1966 35 p refs *Its* Tech. Note 1966
(Contract AF 19(628)-5167; ARPA Order 512)
(ESD-TR-66-245; AD-636144) CFSTI: HC $2.00/MF $0.50

This report describes the results of carrying out a number of seismic signal handling operations in on-line digital equipment at the Large Aperture Seismic Array Data Center in Montana. An appraisal is made of the threshold detection capability of a single LASA sensor by comparison with two well-calibrated stations nearby, UBSO and UMSO. It was found that signals average slightly higher at LASA than at these other stations. When the detection threshold of one LASA sensor is corrected for the predetection processing gain being achieved by current LASA beamformer programs, a LASA detection threshold for event detection by surveillance is established. This number is at a C. and G. S. magnitude of 3.7 for 75% detection or 3.5 for 50% detection by a single LASA for events 30 to 90 degrees away. Some further improvement is possible by more careful on-line beam processing. A combination of automatic event detection and location programs working from individual subarrays is described. This program has been used on single seismometer outputs, giving a 75% threshold for detection and location at a C. and G.S. magnitude around 4.2. Methods for lowering this by various predetection processing schemes are compared. Author (TAB)

N66-37219*# New Hampshire Univ., Durham. Dept. of Physics.
MEASUREMENTS OF IONOSPHERIC CURRENTS
Nelson Charles Maynard (Ph.D. Thesis) Apr. 1966 177 p refs
(Grant NsG-33)
(NASA-CR-78234; UNH-66-2) CFSTI: HC $5.00/MF $1.25 CSCL 04A

Eight Nike–Apache rockets were instrumented to study the veritcal current distribution of the equatorial electrojet over India and off the coast of Peru, to study the vertical current distributions of the S_q current system at low latitudes off the coast of Peru, to determine if the lunar current system is separate from, or part of, the S_q system, and to correlate these measurements with simultaneous electron density measurements. A night flight over India showed the nighttime currents effect to be less than 10γ. Other flights indicated that the electrojet from India is an intense layer of current centered about 109 km with a more diffuse tail extending to higher altitudes. A second layer may be centered between 140 and 145 km near the electrojet's center. The contribution ratio of the ionospheric currents at the ground to the total change in magnetic field on the ground is about 2/3. Since no reverse currents were observed during maximum negative effect of the lunar current system, the lunar system is either a normal current modulation or may exist at a higher altitude. Maximums of electron density correlated with current density maximums. Evidence was found that the magnetic field effect on the Langmuir probe is dependent on probe length in the magnetic field direction. Low latitude S_q currents exist at 100 and 120 km. Author

N66-37267*# National Aeronautics and Space Administration, Goddard Space Flight Center, Greenbelt, Md.
THE EARTH'S LONGITUDE GRAVITY FIELD AS SENSED BY THE DRIFT OF THREE SYNCHRONOUS SATELLITES
C. A. Wagner Washington, NASA, Oct. 1966 111 p refs
(NASA-TN-D-3557) CFSTI: HC $3.00/MF $0.75 CSCL 08N

One hundred and fifty-two orbits of three syncronous communications satellites have been analyzed for sensitivity to earth longitude gravity components through third order which are in resonance with them. Eighty-seven orbits are of Syncom 2 with inclination between 32° and 33° and distributed (but not uniformly) in mean geographic longitude between 66° and 305°. Nineteen orbits, distributed with fair uniformity between 173° and 180°, are of the nearly geostationary Syncom 3. Forty-six orbits are of the nearly geostationary Early Bird satellite between 330° and 332° longitude. These orbits were calculated without consideration of resonant gravitational effects. The orbit data was reduced to give a set of essentially nine well determined long term longitude accelerations for these satellites between 66° and 332°. From this reduced acceleration record, after extensive testing, four earth longitude gravity harmonics of second and third order appear to be well discriminated. These harmonics with their standard errors, for which adjustments for sun and moon effects and the probable influence of neglected higher order earth gravity have been made, are: $J_{22}=-(1.816 \pm 0.020)\times 10^{-6}$ (This corresponds to a difference in major and minor axes of the earth's elliptical equator of 69.4 ±0.8 meters), $\lambda_{22}=-(15.4 \pm 0.3)°$, $J_{33}=-(0.171\pm 0.017)\times 10^{-6}$, and $\lambda_3=(24.9\pm 3.3)°$. In addition to these harmonics, a third pair (J_{31}, λ_{31}) was poorly discriminated from the limited acceleration record. Author

N66-37344# Joint Publications Research Service, Washington, D. C.
INVESTIGATION OF THE WIND-WAVE ANGULAR SPECTRUM
U. M. Krylov, S. S. Strekalov, and V. F. Tsyplukhin 16 Sep. 1966 21 p refs Transl. into ENGLISH from Fiz. Atmosfery i Okeana (Moscow), v. 2, no. 7, 1966 p 729–739
(JPRS-37661; TT-66-34089) CFSTI: $1.00

The wind-wave angular spectrum in deep water and its change in the coastal region were examined. The laws of deformation of the angular spectrum in the narrow coastal zone are discussed, and the structure of the angular spectrum in a deep sea for the simplest conditions of wave formation is considered. The experimental data on the energy distribution in the angular spectrum in deep water confirmed the hypothetical dependence, $\cos^{2\vartheta}$. Comparison of measurement data and theoretical calculations indicated that the change of the angular spectrum in the coastal area up to the breaking zone of the waves occurs in accordance with linear hydrodynamic theory based on the hypothesis of the constancy of wave energy flux of the individual spectral components. L.E.W.

N66-37348*# National Aeronautics and Space Administration, Washington, D. C.
SATELLITE GEODESY, 1958–1964
1966 178 p refs
(NASA-SP-94) GPO: HC $0.70; CFSTI: MF $1.25 CSCL 08E

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3. VANGUARD MEASUREMENTS GIVE PEAR-SHAPED COMPONENT OF EARTH'S FIGURE J. A. O'Keefe, A. Eckels, and R. K. Squires p 11–13 refs (See N66-37348 22-13) DERIVATION OF THE EARTH'S GRAVITY FIELD FROM OPTICAL PHOTOGRAPHS OF SATELLITES

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N66-37347*# Technical Univ. of Prague (Czechoslovakia). Observatory.

MOTION OF THE NODAL LINE OF THE SECOND RUSSIAN EARTH SATELLITE (1957β) AND FLATTENING OF THE EARTH

E. Buchar *In* NASA. Washington Satellite Geodesy, 1958–1964 1966 p 9–10 refs Repr. from Nature, v. 182, 1958 p 198–199 (See N66-37346 22-13) GPO: HC $0.70; CFSTI: MF $1.25

By determing the orbital node of an earth satellite, it is shown that these observations may be used to determine the oblateness of the Earth. Data from 33 visual observations were used to derive an expression for the reciprocal value of the earth's flattening. H.S.W.

N66-37348*# National Aeronautics and Space Administration, Washington, D. C. Theoretical Div.

VANGUARD MEASUREMENTS GIVE PEAR-SHAPED COMPONENT OF EARTH'S FIGURE

J. A. O'Keefe, Ann Eckels, and R. K. Squires *In its* Satellite Geodesy, 1958–1964 1966 p 11–13 refs Repr. from Science, v. 129, no. 3348, 27 Feb. 1959 p 565 (See N66-37346 22-13) GPO: HC $0.70; CFSTI: MF $1.25

Calculations indicate that the periodic variations noted in the orbit of the Vanguard satellite, stem from the presence of a third zonal harmonic in the earth's gravitational field. It was found that the amplitude of the third zonal harmonic is 0.0047 cm/sec^2 in the surface acceleration of gravity, or 15 meters of undulation in the geoid. Supporting arguments are given and it is stated that the presence of a third harmonic of the amplitude calculated, indicates a crustal load of 2×10^7 dy/cm^2. H.S.W.

N66-37349*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.

CURRENT KNOWLEDGE OF THE EARTH'S GRAVITATIONAL FIELD FROM OPTICAL OBSERVATIONS

W. M. Kaula *In* NASA, Washington Satellite Geodesy, 1958–1964 1966 p 17–36 refs (See N66-37346 22-13) GPO: HC $0.70; CFSTI: MF $1.25

The analysis of Baker-Nunn camera observations is described. Solutions were made for all geodetic and gravitational parameters estimated to have effects of more than ±20 meters on satellite orbits. The geometry and dynamics of the observations are discussed. Tables which summarize the gravitational coefficient solutions, and compare geometric and gravitational geoid heights are provided. The descrepancies found are noted. H.S.W.

N66-37350*# Smithsonian Astrophysical Observatory, Cambridge, Mass.

TESSERAL HARMONICS OF THE GEOPOTENTIAL AND CORRECTIONS TO STATION COORDINATES

Imre G. Izsak *In* NASA, Washington Satellite Geodesy, 1958–1964 1966 p 37–51 refs Repr. from J. Geophys. Res., v. 69, no. 12, 15 Jun. 1964 p 2621–2630 (See N66-37346 22-13) GPO: HC $0.70; CFSTI: MF $1.25

Attempts to determine the small, large scale, longitude-dependent irregularities in the gravitational field of the earth from their effects on the motion of artificial satellites have progressed; however, it is postulated that the interpretation of satellite observation data is affected by the errors in the assumed coordinates of the Baker-Nunn camera stations. The program for analyzing the Baker-Nunn observations, obtaining least squares estimates of the tesseral harmonics' numerical coefficients, and making corrections to the station coordinates is described. H.S.W.

N66-37351*# Smithsonian Astrophysical Observatory, Cambridge, Mass.

NEW DETERMINATION OF ZONAL HARMONICS COEFFICIENTS OF THE EARTH'S GRAVITATIONAL POTENTIAL

Yoshihide Kozai *In* NASA. Washington Satellite Geodesy, 1958–1964 1966 p 53–79 refs Previously Published as SAO Spec. Rept.-165 (See N66-37346 22-13) GPO: HC $0.70; CFSTI: MF $1.25

(Grant NsG-87-60)

(SAO Special Rept.-165)

The previous values derived from observations of earth satellites neglected the high inclination satellites. It was found that secular motions of ascending nodes of these satellites could not be accurately expressed. The values derived for the zonal harmonics coefficients of the earth's gravitational field, which include observations of high inclination satellites, are presented. H.S.W.

N66-37352*# Applied Physics Lab., Johns Hopkins Univ., Silver Spring, Md.

DETERMINATION OF THE NON-ZONAL HARMONICS OF THE GEOPOTENTIAL FROM SATELLITE DOPPLER DATA

W. H. Guier *In* NASA. Washington Satellite Geodesy, 1958–1964 1966 p 87–91 refs Repr. from Nature, v. 200, no. 4902, 12 Oct. 1963 p 124–125 (See N66-37346 22-13) GPO: HC $0.70; CFSTI: MF $1.25

(Contract NOw-62-0604-c)

A least squares determination of the values for the coefficients C_n^m and S_n^m of the non-zonal harmonics of the geopotential was made through n=m=4 using Doppler data from three satellites. The Doppler data chosen for the determination are listed. The principal ionospheric refraction contribution was removed by coherently combining two frequencies received simultaneously from the satellite in the Doppler receiving equipment. The data were grouped by days, and a least squares determination of a satellite orbit for each group was made, resulting in no computed arc of the satellite motion lasting more than 24 hours. The least squares procedure used is described briefly, and table of the values obtained is provided. H.S.W.

N66-37353*# Institut Geographique National, Hann-Dakar (Senegal).

GEODETIC JUNCTION OF FRANCE AND NORTH AFRICA BY SYNCHRONIZED PHOTOGRAPHS TAKEN FROM ECHO I SATELLITE

H. M. Dufour *In* NASA. Washington Satellite Geodesy, 1958–1964 1966 p 109–120 (See N66-37346 22-13) GPO: HC $0.70; CFSTI: MF $1.25

The principles of triangulation by satellite are reviewed briefly, the instruments needed are described, and the field operations are discussed. The results obtained are assessed and methods for increasing the precision of the measurements are listed. H.S.W.

N66-37354*# Applied Physics Lab., Johns Hopkins Univ., Silver Spring, Md.

GEOMETRIC GEODESY BY USE OF DOPPLER DATA

Robert R. Newton *In* NASA. Washington Satellite Geodesy, 1958–1964 1966 p 121–123 ref (See N66-37346 22-13) GPO: HC $0.70; CFSTI: MF $1.25

It is shown that the relative horizontal position of two tracking stations can be obtained using the Doppler data from a single pass, with a standard deviation of 10 to 15 meters. By using more passes, all three coordinates of the relative position can be determined. Using data from six TRANET stations across the continental U.S., relative positions were obtained in all three dimensions with a confidence level of 10 meters. H.S.W.

N66-37356*# Air Force Cambridge Research Labs., Badford, Mass. Terrestrial Sciences Lab.

RESULTS FROM SATELLITE (ANNA) GEODESY EXPERIMENTS

Owen W. Williams, Paul H. Dishong, and George Hadigeorge *In* NASA. Washington Satellite Geodesy, 1958–1964 1966 p 129–138 refs (See N66-37346 22-13) GPO: HC $0.70; HC $0.70; CFSTI: MF $1.25

Operation of the optical system in the ANNA 1-B geodetic satellite is described to demonstrate the feasibility of using multi-angulation space surveying techniques to obtain geodetic data. The defective capacitor bank, which caused a malfunction in the optical system, is mentioned. Results of the Long Line Azimuth and the Gulf Test reductions demonstrate that the PC-1000 geodetic stellar camera system is operationally capable of extending geodetic control to a proportional accuracy of better than 1/100,000 when cameras in a network simultaneously observe a flashing satellite beacon. S.P.

N66-37357*# Army Corps of Engineers, Washington, D. C. Topography and Military Engineering Office.

SECOR FOR SATELLITE GEODESY

T. J. Hayes *In* NASA. Washington Satellite Geodesy, 1958–1964 1966 p 139–152 (See N66-37346 22-13) GPO: HC $0.70; CFSTI: MF $1.25

A geodetic electronic ranging system, the sequential collation of range (SECOR), designed to make use of the intermediary space portions of artificial satellites for determining geodetic positions on earth is described. It is composed of at least four identical ground stations and an earth-orbiting satellite carrying a SECOR transponder. Each SECOR ground station consists of three air-transportable shelters: the radio frequency shelter, the data handling shelter, and a storage shelter. The spaceborne portion of the SECOR system consists of a transponder which may be mounted in its own separable satellite or installed as an integral part of a larger satellite. The two principal modes of operation are simultaneous and orbital; however, the simultaneous mode is used except when geography forces the use of the orbital mode. The line crossing analysis presented demonstrates that ranging accuracy controls the geodetic distance error propagation at low elevation angles. When the elevation angles exceed 30°, station height and vehicle height errors predominate. S.P.

N66-37358*# National Aeronautics and Space Administration, Goddard Space Flight Center, Greenbelt, Md.

A REVIEW OF GEODETIC PARAMETERS

William M. Kaula *In* NASA. Washington Satellite Geodesy, 1958–1964 1966 p 161–169 refs Presented at the Intern. Astron. Union Symp. No. 21, Paris, 27–31 May 1963 (See N66-37346 22-13) GPO: HC $0.70; CFSTI: MF $1.25

Gravitational and geometrical parameters used in orbital computation are discussed, and standard methods of describing and transforming tracking station positions are recommended. Recommendations are based on current practice, available determinations, and anticipated improvements. Errors in tracking station positions are examined with respect to astronomical application of geodetic data. Station position errors are attributed to both inadequate data and mistaken treatment of data. It is suggested that these errors are the major cause of discrepancies in space probe trajectories. To help minimize unnecessary errors it is suggested that organizations publish specified information pertaining to each tracking station for which they give any precise observations of artificial satellites or probes. S.P.

N66-37362*# IIT Research Inst., Chicago, Ill. Astro Sciences Center.
SYNOPTIC DESCRIPTION OF THE 5577 Å NIGHTGLOW NEAR 78° WEST LONGITUDE
J. A. Greenspan and J. H. Woodman [1966] 24 p refs
(Contract NASr-65(11))
(NASA-CR-78175) CFSTI: HC $1.00/MF $0.50 CSCL 04A

This paper describes the diurnal and latitudinal variations in the 5577 Å zenith nightglow intensity, as observed during a shipboard expedition along the Pacific coast of South America. These results show good agreement with a similar set of data obtained in 1962. Comparison of these data with simultaneously obtained results for the 6300 Å nightglow suggest that, on a gross scale, the excitation patterns for these two emissions are unrelated. Author

N66-37366*# Geological Survey, Flagstaff, Ariz.
INVESTIGATION OF *IN SITU* PHYSICAL PROPERTIES OF SURFACE AND SUBSURFACE SITE MATERIALS BY ENGINEERING GEOPHYSICAL TECHNIQUES Annual Report, Fiscal Year 1966
Joel S. Watkins, ed. Jul. 1966 373 p refs
(NASA Order T-25091(G))
(NASA-CR-65502) CFSTI: HC $4.25/MF $2.00 CSCL 08G

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N66-37367*# Geological Survey, Flagstaff, Ariz.
***IN SITU* PHYSICAL PROPERTIES MEASUREMENTS**
Lawrence A. Walters *In its* Invest. of *In Situ* Phys. Properties of Surface and Subsurface Site Mater. by Eng. Geophys. Tech. Jul. 1966 p 7–24 refs (See N66-37366 22-13) CFSTI: HC $4.25/MF $2.00

In situ bulk density, moisture content, bearing capacity, shear strength, and compressional wave velocity were determined simultaneously on seven lunar analog sites. Bearing capacities ranged from 3.4×10^4 to 45.9×10^6 dynes per cm^2 (0.5–675 psi). Density ranged from 0.43 to 1.87 g per cc. A large range of properties for the same material was found for various physical states of the material. Author

N66-37368*# Geological Survey, Flagstaff, Ariz.
CORRELATION OF PHYSICAL PROPERTIES—FROM LABORATORY MEASUREMENTS AND FROM *IN SITU* MEASUREMENTS
Joel S. Watkins, Carl H. Roach, and Ralph P. Christian *In its* Invest. of *In Situ* Phys. Properties of Surface and Subsurface Site Mater. by Eng. Geophys. Tech. Jul. 1966 p 25–38 refs (See N66-37366 22-13) CFSTI: HC $4.25/MF $2.00

Physical properties data have been measured in the laboratory from cores taken from the more than 600 m of NX diameter core collected at 10 lunar analog sites during the past 18 months. Core data from six sites have been examined in detail including preparation of 48 scatter diagrams in an attempt to find relationships between the measured physical properties. Correlations from the laboratory measurements have been poor at best and generally unrewarding. Correlation of 23 *in situ* measurements of bulk density and P-wave velocities are encouraging. Author

N66-37370*# Geological Survey, Flagstaff, Ariz.
LIMITS OF HEAD-WAVE AMPLITUDES FOR SHORT SPREADS FROM VARIOUS CHARGE SIZES, BLASTING CAPS, AND 45-kg WEIGHT DROP
Hans D. Ackermann *In its* Invest. of *In Situ* Phys. Properties of Surface and Subsurface Site Mater. by Eng. Geophys. Tech. Jul. 1966 p 41–49 ref (See N66-37366 22-13) CFSTI: HC $4.25/MF $2.00

Measurements of head-wave amplitudes obtained with various charge sizes at 12 in situ test sites have been normalized to a standard distance (30 m) and charge size (.05 kg dynamite). The upper and lower bounds of head-wave amplitudes as a function of distance for the standard charge have been estimated and empirical relationships determined to predict such bounds when other charge sizes, blastings caps, or 45-kg weight drops are used as the energy source. Only distance less than 300 m are considered. Author

N66-37371*# Geological Survey, Flagstaff, Ariz.
STRUCTURE AND COMPOSITION OF THE SOUTHERN COULEE, MONO CRATERS, CALIFORNIA
Robert A. Loney *In its* Invest. of *In situ* Phys. Properties of Surface and Subsurface Site Mater. by Eng. Geophys. Tech. Jul. 1966 p 51–92 refs (See N66-37366 22-13) CFSTI: HC $4.25/MF $2.00

The Southern Coulee is the southernmost and largest of the four recent pumiceous rhyolite coulees, or stubby flows, of the Mono Craters, eastern California. The coulee is 3.6 km long and averages 1.2 km wide and has a minimum thickness of 150 m. The coulee has three main parts: the dome, located over the orifice, where flow was about vertical; the flow, where movement was lateral; and the talus slope, which surrounds the coulee and which formed from the advancing steep flow front. Three distinct lithologic units based on rock density or degree of vesicularity have been mapped. Contracts between units are abrupt in spite of the fact that core drilling has shown the coulee to be a jumbled mass of blocks down to at least a depth of 45 m. The two less dense units, which consist of highly inflated, thickbedded pumice, form two connecting, boat-shaped outcrops along the entire south margin of the coulee. The petrographic and chemical data indicate a uniform composition for the lava that belies its heterogeneous aspect. The lava is composed almost entirely of clear glass (average $n_D = 1.488 \pm .001$) and contains only trace amounts of microlites and cristobalite-sanidine spherulites. Eight chemical analyses show a silica range of from 74.7 to 76.2 percent and indicate a rhyolite of the sodipotassic subrange. This composition is characteristic of glassy fluidal rhyolites. Author

N66-37372*# Geological Survey, Flagstaff, Ariz.
GEOLOGY AND PETROGRAPHY OF THE SONORA PASS SITE, MONO COUNTY, CALIFORNIA
David V. Haines *In Situ* Phys. Properties of Surface and Subsurface Site Mater. by Eng. Geophys. Tech. Jul. 1966 p 93–113 refs (See N66-37366 22-13) CFSTI: HC $4.25/MF $2.00

The Sonora Pass site is located in the Sierra Nevada on a quartz monzonite pluton. Outcrops consist of relatively unweathered, jointed, sheeted, and exfoliated rock. Rock surfaces are generally smooth with rounded edges. Slopes are usually less than 15 degrees. Irregularities in the terrain are due to erosion along joints by running water. Petrographic examination of drill core to a depth of 12.2 meters indicates the rock is a homogeneous, medium-grained porphyritic quartz monzonite consisting of pink microcline, zoned plagioclase, quartz, biotite, and minor accessory minerals. Author

N66-37373*# Geological Survey, Flagstaff, Ariz.
PETROGRAPHY AND GEOLOGY OF BISHOP TUFF AND MONO ASH SITES, CALIFORNIA
David V. Haines *In its* Invest. of *In Situ* Phys. Properties of Surface and Subsurface Site Mater. by Eng. Geophys. Tech. Jul. 1966 p 115–170 refs (See N66-37366 22-13) CFSTI: HC $4.25/MF $2.00

Two test sites, selected on the basis of geologic lunar analogies, indicate petrographic and physical characteristics pertient to lunar exploration and interpretation of lunar terrains. The Bishop Tuff site is located on a gently sloping, predominantly flat tableland broken by northerly-trending faults and underlain by Pleistocene Bishop Tuff in a youthful stage of erosion. Drilling indicates the prwsence of well-indurated tuff to 18.6 m, underlain by unconsolidated ash. The Mono Ash site is located on a gently sloping, predominantly flat surface underlain by pyroclastic debris derived from the adjacent Mono Craters. The surface soil is loose, dry lapilli ash of late Pleistocene to recent age, and is underlain by similar moist soil. Drill core shows the surface soil to be underlain by ash and consolidated pumice to a depth of 47 m. Occasional beds of clastic sand, up to 3.7 m thick, are interbedded with the pumice and ash and represent deposits formed in pulvial Lake Russell. Tuff (probably equivalent to the previously mentioned Bishop Tuff) occurs below a depth of 47 m. Strongly eutaxitic texture, spherulitic structure developed in pumice inclusions, and flattened lenses containing obsidian indicate higher temperature and pressure conditions during deposition than occurred at the Bishop Tuff site. Petrographic features can be correlated with higher bulk density and lower porosity of the tuff at the Mono Ash site. Author

N66-37374*# Geological Survey, Flagstaff, Ariz.
PETROGRAPHY OF METEOR CRATER CORE 4, METEOR CRATER, ARIZONA
David V. Haines *In its* Invest. of *In Situ* Phys. Properties of Surface and Subsurface Site Mater. by Eng. Geophys. Tech. Jul. 1966 p 171–193 ref (See N66-37366 22-13) CFSTI: HC $4.25/MF $2.00
Geophys. Tech. Jul. 1966 p 171–193 ref (See N66-37366 22-13) CFSTI: HC $4.25/MF $2.00

A 107-m diamond drill core hole on the south rim of Meteor Crater recovered core from the debris zone, Moenkopi formation, and Kaibab Limestone. The drill core and petrographic examination of thin sections indicate an inverted stratigraphic sequence in the debris zone, which is 10.0 m thick. The Moenkopi formation beneath the debris zone is a very fine-grained calcareous sandstone 10.1 m thick, with shaly intervals comprising about 15 percent of the formation. The Kaibab limestone, of which 87.3 m were cored, consists of sandy dolomite in the upper 25 percent of the section, very fine-grained sandy dolomite interbedded with dolomitic sandstone in the middle 60 percent of the section, and very fine grained calc-dolomitic sandstone in the lower 15 percent. Dolomite is relatively coarse-grained above 24.8 m and microcrystalline granular below 24.8 m. Author

N66-37377*# Smithsonian Astrophysical Observatory, Cambridge, Mass.
GEOMAGNETIC PERTURBATIONS AND UPPER-ATMOSPHERE HEATING
L. G. Jacchia, J. Slowey, and F. Verniani 22 Aug. 1966 36 p refs
(Grant NsG-87-60)
(NASA-CR-78225; SAO Specia Rept.-218) CFSTI: HC $2.00/MF $0.50 CSCL 04A

The density variations that accompany geomagnetic disturbances have been studied by analyzing the drag of three satellites with high orbital inclination (Injun 3, Explorer 19, and Explorer 24) and one with moderate inclination (Explorer 17). The average time delay between the peak of the geomagnetic perturbation and that of the atmosphere is 6.7 ±0.3 hours. While there seems to be no significant dependence of the time delay on the intensity of the perturbation and on the geographic location with respect to the sun, there appears to be some dependence on latitude. The observed density changes are interpreted as caused by changes in temperature. For smaller perturbations ($K_p < 5$) the temperature T shows a nearly linear dependence on K_p, and for latitudes lower than 55° the rate of change $\Delta T/\Delta K_p$ is about 28°. For latitudes above 55° (average: 65°) $\Delta T/\Delta K_p$ seems to be about 15 to 25 percent greater. For more intense disturbances ($K_p \geq 5$), $\Delta T/\Delta K_p$ is systematically larger, confirming the nonlinearity of the relation between T and K_p when considered over its total range. Author

N66-37381# Boeing Scientific Research Labs., Seattle, Wash. Geo-Astrophysics Lab.
AN EXPERIMENTAL EVALUATION OF VARIOUS RIGIDITY MODELS
J. F. Kenney, J. Gauger, M. A. Shea, and D. F. Smart (Douglas Aircraft Co., Inc., Huntington Beach, Calif.) May 1966 29 p refs Prepared in Cooperation with AFCRL and Douglas Aircraft Co.
(DI-82-0529; AD-636093) CFSTI: HC $2.00/MF $0.50

Atmospheric cosmic-ray fluxes have recently been measured over large portions of the globe on a series of flights of a United States Air Force jet aircraft. The measured fluxes have been plotted as a function of the vertical cutoff rigidity for several different models. The rigorous trajectory calculations of Shea et al give good agreement with the counting rates. The Makino model also orders these data equally well, and therefore must be within a few percent of the value determined by rigorous orbit calculations taken over the portions of the globe covered in this survey. The other models are demonstrably worse, and a discussion of where these models are inadequate is given. Particular attention is paid to the use of the L parameter as a substitute for rigorous integration procedures. It is shown both experimentally and theoretically that the L parameter is not a good demographic parameter for galactic cosmic radiation at the lower latitudes, but should be sufficiently accurate at higher latitudes for most purposes. Author (TAB)

N66-37384# Air Force Cambridge Research Labs., Bedford, Mass. Aerospace Instrumentation Lab.
HORIZONTAL AND VERTICAL DISTRIBUTIONS OF ATMOSPHERE PRESSURE, 30 TO 80 KILOMETERS Interim Scientific Report

Arthur J. Kantor May 1966 19 p refs *Its* AF Surv. in Geophys. No. 181
(AFCRL-66-346; AD-635926) CFSTI: HC $1.00/MF $0.50

The distribution with latitude of atmospheric pressure is such that mean monthly pressures generally increase toward the equator in winter and toward the pole in summer. The mean maximum January gradient lies between 60° and 40°N, where the pressure changes by roughly one percent of standard per degree of latitude. The height of smallest change is near 85 km. The largest January and July departures from standard occur near 65 km in the arctic where the minimum January value is 65 percent of standard and the maximum in July is 130 percent of standard. A pressure increase near 60 km of more than seven percent per degree of latitude can result from coexistence of cold and warm winter stratospheric thermal regimes within 600 miles over arctic regions. An extreme vertical pressure gradient of 23 percent decrease per km may exist near 65 km for the coldest observed temperature, 130°K, at this level. Day-to-day variability of pressure increase with the latitude and altitude to near 65 km. Estimated 2 standard deviations near 65 km reach ±35% during 60°N winter. Theoretical diurnal pressure variations increase with height above 30 km to at least 80 km. Author (TAB)

N66-37402# Uppsala Univ. (Sweden). Inst. of High Tension Research.
RESEARCHES OF WHISTLER PHENOMENA Final Report, 1 Apr. 1963–30 Apr. 1966
Harald Norinder 15 May 1966 9 p refs
(Contract AF 61(052)-687)
(AFCRL-66-493; AD-636255) CFSTI: HC $1.00/MF $0.50

Analysis was carried out of simultaneously occurring whistlers at three adjacent stations in Sweden at 55, 57, 58 degrees geomagnetic latitudes. Investigations were made to prove the existence of echoes from unusual whistlers.
Author (TAB)

N66-37405# Florida State Univ., Tallahassee. Dept. of Meteorology.
THE VERTICAL DISTRIBUTION OF OZONE OVER TALLAHASSEE, FLORIDA Scientific Report No. 1
Philip R. Sticksel 15 Jun. 1966 158 p refs *Its* Rept.-66-3
(Contract AF 19(628)-4953; Grant NSF GP-2393)
(AFCRL-66-351; AD-635914) CFSTI: HC $5.00/MF $1.00

158 Regener chemiluminescent ozonesondes were launched from Tallahassee, Florida, (30.5 as part of a three-year synoptic sounding program for the investigation of the vertical distribution of ozone over North America. In general, there was single maximum of ozone density located near 23 km above Tallahassee throughout the year. The increase to this maximum began at the tropical tropopause and at least 80 percent of the total amount of ozone was located above this tropopause. Relative maxima below this level occurred during the first half of the year and their appearance could be related to the presence of the subtropical jet stream south of Tallahassee and to the horizontal movement of 'ozone clouds' within the layer between the tropical and subtropical tropopauses. The formation process of these secondary maxima was investigated by constructing isentropic trajectories to trace the movements of the maxima. An inquiry into the cause of a 40 percent variation of total ozone during a 10-day period indicated that it resulted primarily from horizontal and vertical motions between 16 and 24 km and secondarily from horizontal advection between 12 and 16 km. In both layers these processes were found to be under the control of middle latitude circulation systems. Author (TAB)

N66-37441# Saskatchewan Univ., Saskatoon. Inst. of Upper Atmospheric Physics.
BASIC RESEARCH ON AURORA AND AIRGLOW Final Report, 1 May 1963–30 Apr. 1966
A. Vallance Jones, H. N. Rundle, and E. J. Llewellyn 30 Apr. 1966 50 p refs
(Contract AF 19(628)-2829)
(AFCRL-66-343; AD-635866) CFSTI: HC $3.00/MF $0.50

Spectroscopic grating and interferometric instruments currently in use for the spectroscopy and photometry of the aurora and airglow are listed and descriptions are given of the most recently developed instruments. A balloon-borne photometer for the infrared is described. Measurements of alkali metal abundances in the atmosphere from twilight observations are reported, including enhancements following artificial injections. Experimental and theoretical observations of the 1.27 micron and 1.58 micron O_2 band in the twilight and dayglow are described including recent results obtained from balloons. An investigation on the relative band intensities and excitation of the nitrogen band systems in aurora was completed and the results are reported. Temperatures were obtained from the rotational structure of the first positive group N_2 and Vegard–Kaplan bands in aurora. Lifetimes and quenching cross sections for O singlet-S were obtained from multichannel photometer observations of auroral brightness fluctuations. High resolution spectra of the OH bands in the 1–2 micron infrared region were obtained with a Michelson interferometer. A synoptic program for the determination of the time and space distributions of proton and electron bombardment of the atmosphere from the analysis of patrol spectra is described. Author (TAB)

N66-37455# Naval Oceanographic Office, Washington, D. C. Hydrographic Surveys Dept.
GEOMAGNETIC SURVEYS, 1953–1965
1966 74 p refs *Its* Brochure No. 3
(Proj. Magnet)
(AD-635686) CFSTI: HC $3.00/MF $0.75

Since 1953, the U. S. Naval Oceanographic Office has conducted geomagnetic surveys over various ocean areas of the world. Information on survey locations, dates, navigational control, track patters, data format, and availability of geomagnetic technical reports, charts, and other publications is presented. Author (TAB)

N66-37468# Institut d'Aeronomie Spatiale de Belgique, Brussels
MINOR CONSTITUENTS IN THE STRATOSPHERE AND THE MESOSPHERE [LES CONSTITUANTS MINORITAIRES DANS LA STRATOSPHERE ET DANS LA MESOSPHERE]
M. Nicolet 1965 46 p refs In FRENCH; ENGLISH; GERMAN and DUTCH summaries Presented at Symp. on the Meteorol. Probl. in the Stratosphere and Mesosphere, Paris, 8–12 Mar. 1965 Submitted for Publication
(A-41-1965) CFSTI: HC $2.00/MF $0.50

The reactions in which atomic hydrogen is involved are described. The atmospheric behavior of ozone is shown to be related to the presence of atomic hydrogen H and its radicle OH. Author (ESRO)

N66-37481# Institut d'Aeronomie Spatiale de Belgique, Brussels.
ATMOSPHERIC HYDROGEN
D. R. Bates and M. Nicolet 1965 14 p refs Submitted for Publication
(A-39-1965) CFSTI: HC $1.00/MF $0.50

Attention is drawn to the possibility that $H + HO_2 \rightarrow H_2 + O_2$ may be an important source of hydrogen molecules in the lower thermosphere. It is suggested that the fractional volume abundance of hydrogen atoms (free and combined) in this region is determined by, and is not very much less than, the corresponding fractional volume abundance in the stratosphere. Any hydrogen molecules in the lower thermosphere would affect the altitude distribution of hydrogen atoms and augment their rate of escape.

Author (ESRO)

N66-37496# Institut d'Aeronomie Spatiale de Belgique, Brussels.

PANORAMA OF THE TERRESTRIAL ATMOSPHERE [PANORAMA DE L'ATMOSPHERE DE LA TERRE]

M. Nicolet 1966 25 p refs In FRENCH; ENGLISH, DUTCH and GERMAN summaries Submitted for Publication

(A-43-1966) CFSTI: HC $1.00/MF $0.50

A brief nontechnical description of the earth's upper atmospheric structure and composition is given. The problem of highly energetic particles in the magnetosphere is not considered in this paper. Author (ESRO)

N66-37497# Royal Inst. of Tech., Stockholm (Sweden). Dept. of Plasma Physics.

A PRELIMINARY NOTE ON THE POSSIBILITY OF OBSERVING SUNLIT AURORAS IN THE HEIGHT RANGE 100–200 KM

Rolf Bostroem Jan. 1966 11 p refs

(Rept.-66-01) CFSTI: HC $1.00/MF $0.50

The time in minutes per day during which an aurora of a certain brightness may be observed, when the region above a certain height is sunlit, is evaluated and compared with the occurrence frequency of such an aurora. Author (ESRO)

N66-37499# Institut d'Aeronomie Spatiale de Belgique, Brussels

MEAN MOLECULAR MASS AND SCALE HEIGHTS OF THE UPPER ATMOSPHERE

G. Kockarts 1966 45 p refs Presented at Symp. on Aeronomy, Cambridge, Mass., 16–20 Aug. 1965 Submitted for Publication

(A-42-1966) CFSTI: HC $2.00/MF $0.50

The physical structure of the upper atmosphere is given in terms of the mean molecular mass and of the pressure and density scale heights. The physical conditions leading to a departure from a perfect mixing are discussed in the lower thermosphere. If helium is in diffusive equilibrium at 120 km, the eddy diffusion coefficient must be less than 2×10^6 cm^2 sec^{-1}, i.e. a value much lower than that one for the molecular diffusion coefficient. By using atmospheric models adapted to a decreasing solar cycle, it is possible to point out the large variations of the mean molecular mass. It is shown, how the atomic oxygen, the helium and the hydrogen belts are changing during a solar cycle. In the thermosphere, the vertical distribution of the atmospheric scale height H is mainly related to the temperature distribution. Above the thermopause, the atmospheric scale height follows the mean molecular mass variations and an increase of H is seen when the temperature decreases. The variations and an increase of H is seen when the temperature decreases. The variations of the pressure and density scale heights are related to the vertical distribution of their gradients. The pressure scale height gradient β goes through a maximum at heights where helium and hydrogen respectively become the major constituent. The density scale height gradient β_ρ is never less than β in the thermosphere. Above the thermopause, β_ρ reaches values higher than β. Author (ESRO)

N66-37609# Institute d'Aeronomie Spatiale de Belgique, Brussels.

THE EARTH'S MAGNETOSPHERE [DE MAGNETOSFEER DER AARDE]

E. Aerts 1966 37 p refs In DUTCH; ENGLISH, FRENCH, DUTCH and GERMAN summaries

(A-44-1966) CFSTI: HC $2.00/MF $0.50

After a brief history of the relationship between terrestrial atmospheric and magnetic phenomena and solar activity, an account is given of the various experimental results obtained from the interplanetary spacecrafts. Next the composition and the geometric aspect of the magnetosphere together with the various corpuscular flows inside the magnetosphere are studied. It is concluded that since our knowledge is still incomplete it is impossible to give a correct picture of the magnetosphere. Author (ESRO)

N66-37621*# Kansas Univ., Lawrence. Engineering Science Div.

FUTURE AND PRESENT NEEDS OF REMOTE SENSING IN GEOGRAPHY

David S. Simonett [1966] 14 p refs Presented at the 4th Symp. on Remote Sensing of the Environment, Mich. Univ., Ann Arbor, 11–14 Apr. 1966

(Contract NSR-17-004-003)

(NASA-CR-78400; CRES-61-12) CFSTI: HC $1.00/MF $0.50 CSCL 08F

Learning how to interpret and evaluate the information contained in different parts of the electromagnetic spectrum is identified as the most pressing problem of remote sensing in geography. Also emphasized is the need for more efficient data gathering, handling, and analytical methods; the development of improved research programs; changes in teaching methods and the use of illustrative material; and the development of commercial pre-processing instruments of differing complexity for use with radar and infrared imagery. The types of information which geographers want are discussed, along with better techniques for disseminating the data. Four future problem areas requiring considerable work by design engineers are delineated. These include the development of hardware and software for automated data handling and manipulation, of operational real-time data recall and handling for research and classroom use, and of remote sensing instruments based on the use of proxies or surrogates for conventional data; and the optimization of all weather data collection systems. M.G.J.

N66-37525*# State Univ. of Iowa, Iowa City. Dept. of Physics and Astronomy.

INFLUENCE OF THE EARTH'S ROTATION UPON THE INTERACTION OF THE SOLAR WIND WITH THE MAGNETOSPHERE

Edward W. Hones, Jr. Jul. 1965 41 p refs *Its* Rept.-65-26

(Grant NsG-233-62)

(NASA-CR-78403) CFSTI: HC $2.00/MF $0.50 CSCL 04A

A theory is presented to account for the coupling of solar wind energy into the magnetosphere. This theory suggests: (1) Thermalized solar wind plasma flows directly into the forward portion of the magnetosphere, probably on the afternoon side of the subsolar region. (2) The earth's rotation is the factor which causes the plasma's entry and which largely determines where the entry will take place. (3) To a large extent, the course that the plasma will follow as it forces its way through the magnetosphere is established by the earth's rotation. The theory is deduced from the electric field configuration in a model of the magnetosphere, and experiments conducted to demonstrate that circulation, established by bodies rotating in a viscous fluid, may be modified and its velocity enhanced if the fluid is streaming past the bodies. N.A.S.

14 INSTRUMENTATION AND PHOTOGRAPHY

Includes design, installation, and testing of instrumentation systems; gyroscopes; measuring instruments and gages; recorders; transducers; aerial photography; and telescopes and cameras.

N66-36523# Radio Corp. of America, Princeton, N. J. Astro-Electronics Div.

LOGIC AND CONTROL SYSTEM FOR A PANORAMIC TELEVISION CAMERA

James A. D'Arcy *In* Canaveral Council of Tech. Soc. 3d Space Congr. 1966 p 235–243 refs (See N66-36506 22-30)

(Contract NAS5-2503)

The dielectric-tape television camera, being developed for use in a meteorological satellite placed in a polar orbit, is described. Emphasis is given to the part of the control system which synchronizes the retrace of the scanning mirror to the cycle of time code being recorded on the tape for identifying adjacent picture frames. Details are presented on the record and playback modes of the control system, and a block diagram of the modes are included. The time code is written longitudinally on the tape during the retrace interval of the scanning mirror and requires that the scanning mirror be synchronized to the time code. The drive mechanism, logic, and circuitry of the scanning mirror synchronization are discussed. It was concluded that the circuits performed with a high degree of reliability during testing. N.E.N.

N66-36528# Boeing Co., Huntsville, Ala.

TEST AND CHECKOUT CONCEPT FOR SPACE TRANSPORTATION SYSTEMS

John M. Miller *In* Canaveral Council of Tech. Soc. 3d Space Congr. 1966 p 301–308 (See N66-36506 22-30)

The development of an on-board test and checkout concept and the design, fabrication and test of a major hardware element of the concept is described. The integration of functions into an overall data management system for future vehicles, with the flight crew assuming the role of ultimate decision maker for resolution of non-nominal occurrences is a logical and obvious extrapolation of current technological developments, and will yield the autonomy required for tomorrows manned missions. Author

N66-36534# Pan American World Airways, Inc., Cocoa Beach, Fla.

INSTRUMENTATION RECORDER SPECIFICATIONS AND TESTS

Glen H. Schulze *In* Canaveral Council of Tech. Soc. 3d Space Congr. 1966 p 370–386 refs (See N66-36506 22-30)

The broadband instrumentation recorder–reproducers, and new measurement techniques advanced by predetection recording requirements are discussed. The recorders are classified according to bandwidth, operational environment, and major field of application. Fundamental differences between recorder classes are outlined. Automated testing is suggested for obtaining more repeatable test results in greater volume. Modular amplifier interchangeability in megacycle recorders was shown to be a cause of performance degradation when indiscriminately intermixing modules without resetting bias and equalization adjustments. New tests and testing techniques which eliminate the conventional logging of data by human hand are presented. These are based on time base error measurements, modulation noise, amplitude vs frequency response, and delay distortion. Magnetic tape is discussed with emphasis on megacycle recorders at 120 ips, and precautions for use with tapes are included. N.E.N.

N66-36553# Pan American World Airways, Inc., Patrick AFB, Fla.

THE EVALUATION AND CALIBRATION OF RANGE INSTRUMENTATION SYSTEMS AT THE AIR FORCE EASTERN TEST RANGE

Charles L. Carroll, Jr. *In* Canaveral Council of Tech. Soc. 3d Space Congr. 1966 p 567–582 refs (See N66-36506 22-30)

A discussion of the status of work on the evaluation and calibration of range instrumentation systems at the Eastern Test Range is presented. The methods pursued include the analysis of test-by-test data collected on operational tests; the use of special tests involving lofted rockets fired primarily for the evaluation of guidance systems and the range instrumentation systems, such as the STAFF project; the study of self-calibrating range instrumentation systems; and the use of range instrumentation calibration satellites. Details are given on each method and the results obtained are assessed. H.S.W.

N66-36665# Weapons Research Establishment, Salisbury (Australia).

INSTRUMENTATION TRIAL DE5/5 ANALYSIS OF INSTRUMENT PERFORMANCE

W. W. Barnes Oct. 1965 20 p refs

(WRE-SAD-40) CFSTI: HC $1.00/MF $0.50

The results of the analysis of records obtained from instrumentation trial DE5/5 are presented and discussed. These show that attempts to remove previously unexplained radar bias errors have been partially successful. Radar angular errors were generally within specification. However, there were large range bias errors. The performances of the Contraves and Askania systems were satisfactory. The ballistic cameras at the Rangehead did not produce satisfactory records as the flashing light was too far from the cameras to be photographed clearly. The ballistic cameras at Mirikata produced satisfactory records. The problems of target noise and atmospheric refraction are dealt with and the results of investigations into these two phenomena are given. Author

N66-36669# Joint Publications Research Service, Washington, D. C.

APPLICATION OF GEODETIC INSTRUMENTS IN HUNGARY

13 Sep. 1966 31 p Transl. into ENGLISH from Geodezia es Kartografia (Budapest), v. 18, no. 3, 1966 p 191–194; 206–213; 222–223

(JPRS-37558; TT-66-33986) CFSTI: $2.00

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1. HUNGARIAN PRODUCTION OF GEODETIC INSTRUMENTS Gyorgy Balogh and Janos Fekete p 1–16 refs

2. GEODETIC USE OF THE HUNOR 131 Gyorgy Winkler p 17–24

3. THE EAST GERMAN COORDIMETER D. K. Szangolies p 25–27

N66-36699*# Lockheed Missiles and Space Co., Sunnyvale, Calif.

DRAG MAKE-UP SENSOR FOR LOW-ALTITUDE SATELLITES

William R. Davis *In* JPL 1st Aerospace Mech. Symp. [1966] 11 p refs (See N66-36691 22-31) CFSTI: HC $7.00/MF $2.00

An air drag compensation system is described which utilizes the almost total lack of sensible weight or net force in the satellites. The sensor system uses a caged tungsten ball as a proof mass, which is free to move only along the vehicle roll axis. Displacement along the cage axis is measured by a phototransistor, and this information is used to control thrust on the vehicle and prevent the ball from contacting either end of the cage. The theory of operation is presented, and the control system and drag make-up performances are discussed. N.E.N.

N66-36700*# Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena.

SPACECRAFT HYDRAULIC TIMERS

Harland D. Trimble *In its* 1st Aerospace Mech. Symp. [1966] 9 p (See N66-36691 22-31) CFSTI: HC $7.00/MF $2.00

The design of the timers used on Ranger Block III and Mariner IV to provide triggering for celestial events is described. The timer uses a spring-loaded piston to force silicone oil through a capillary tube. The variation of timer performance with temperature is discussed, and the mechanical and electrical designs are covered. N.E.N.

N66-36714*# Lockheed Missiles and Space Co., Sunnyvale, Calif.

ANALYSIS OF A SATELLITE ANGLE-OF-ATTACK SENSOR

William E. Frye *In* JPL 1st Aerospace Mech. Symp. [1966] 9 p refs (See N66-36691 22-31) CFSTI: HC $7.00/MF $2.00

The direction of the deceleration due to airdrag on an attitude-stabilized satellite is sensed by a simple pendulum immersed in a damping fluid. Considered is the manner in which the device responds to perturbations caused by attitude oscillations, variations in air density, orbit eccentricity, gravity gradient, and internal instrumental perturbations. Restrictions on the location of the device relative to the center of mass of the vehicle and the choice of damping fluid are also discussed. Author

N66-36723# Joint Publications Research Service, Washington, D. C.

SOVIET PROGRESS IN INSTRUMENT BUILDING AND CONTROL SYSTEMS

K. Rudnev 13 Sep. 1966 13 p refs Transl. into ENGLISH from Nauchino-Tekhn. Obshchestva (Moscow), no. 6, Jun. 1966 p 1-3

(JPRS-37569; TT-66-33997) CFSTI: $1.00

Various aspects of automation in industry are reviewed in light of new instruments and control systems. Vibrometric instruments essential for turbines, airplanes, and electric motors are cited as a new development. A control system for ammonia production is described, and automation of basic processes in ferrous metallurgy and operation of open-hearth furnaces is discussed. The need for similar systems in transportation, communications, and municipal utilities is stressed. S.P.

N66-36766*# Hughes Research Labs., Malibu, Calif.

RESEARCH ON GRAVITATIONAL MASS SENSORS Final Report, 15 Oct. 1964-15 Apr. 1966

Robert L. Forward [1966] 436 p refs

(Contract NASw-1035)

(NASA-CR-77933) CFSTI: HC $7.36/MF $2.25 CSCL 04B

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6. MAGNETIC BEARING AND DRIVE 12 p (See N66-36770 22-14)
7. FOUR SPRING MOUNT ANALYSIS (2-D) 12 p (See N66-36771 22-15)
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9. ROTATING TENSOR SENSORS R. L. Forward 10 p refs (See N66-36773 22-14)
10. ROTATING GRAVITATIONAL AND INERTIAL SENSORS R. L. Forward 7 p refs (See N66-36774 22-14)
11. MASS DETECTION BY MEANS OF MEASURING GRAVITY GRADIENTS C. C. Bell, R. L. Forward, and J. R. Morris 21 p refs (See N66-36775 22-14)
12. VIBRATIONAL MODE BEHAVIOR OF ROTATING GRAVITATIONAL GRADIENT SENSORS R. L. Forward, J. M. Richardson, C. C. Bell, and J. R. Morris 40 p refs (See N66-36776 22-14)
13. GENERATION AND DETECTION OF DYNAMIC GRAVITATIONAL GRADIENT FIELDS R. L. Forward and L. R. Miller 28 p refs (See N66-36777 22-14)
14. NONIDEAL BEHAVIOR OF ROTATING GRAVITATIONAL MASS SENSORS D. Berman 68 p refs (See N66-36778 22-14)

N66-36767*# Hughes Research Labs., Malibu, Calif.

THEORY OF RADIALLY VIBRATING GRAVITATIONAL MASS SENSORS

In its Res. on Gravitational Mass Sensors [1966] 17 p refs (See N66-36766 22-14) CFSTI: HC $7.36/MF $2.25

A numerical analysis was performed to determine whether it was possible to find a stable version of a radially vibrating structure. A system which is shown schematically, is assumed for the calculations of the operation of a freely falling radially vibrating gravitational mass sensor. The sensor consists of two equal masses M_1 and M_2 connected by massless springs to a central mass M_3. The sensor is rotating in free fall near an object with mass M_4. The motion equations of the four masses are written, and then combined and manipulated into a useful polar coordinate form. The motion equations and an equation expressing the conservation of angular momentum are solved to obtain a pair of equations describing the radial vibrations of each spring. These equations are examined to determine the response of the sensor to the gravitational gradients produced by the mass M_4. A.G.O.

N66-36768*# Hughes Research Labs., Malibu, Calif.
GRAVITATIONAL RADIATION DETECTORS
In its Res. on Gravitational Mass Sensors [1966] 10 p refs (See N66-36766 22-14) CFSTI: HC $7.36/MF $2.25

Gravitational radiation antenna research is described which has led to the development of piezoelectric transducer techniques for measuring motions as small as 3×10^{-14} cm, and for detecting dynamic gravitational gradients as small as 3×10^{-13} sec^{-2}. Emphasis is placed on the construction, test, and operation of a gravitational detector to sense gravitational radiation from astronomical objects. The propagation of gravitational radiation and the detection of radiation waves are discussed briefly, and the detector configuration is described. A photograph of the detector and diagrams showing transducer placement and the quartz strain transducer are presented. It is reported that with the antenna matched to the preamplifier and with the acoustic, seismic, and electrical filters in place, it was found possible to reduce the noise input to the antenna to the point where its sensitivity was limited only by its own internal thermal noise. Antenna calibration using a generator of dynamic Newtonian gravitational fields is also related. A.G.O.

N66-36770*# Hughes Research Labs., Malibu, Calif.
MAGNETIC BEARING AND DRIVE
In its Res. on Gravitational Mass Sensors [1966] 12 p (See N66-36766 22-14) CFSTI: HC $7.36/MF $2.25

A magnetic bearing and drive system capable of supporting a composite rotor having a weight in excess of 5 lb. is described. It is reported that the drive system is capable of accelerating the rotor up to angular speeds in excess of 1000 rps when the rotating components are enclosed in a vacuum tight chamber maintained at a pressure not exceeding 50μ Hg. The major components of the support system including the magnetic support solenoid and drive motor assembly, magnetic support circuit, current control circuit, rotor drive circuit, and speed pickup system are discussed. Mechanical relationships between the magnetic support solenoid and drive motor assembly components are shown, and a block diagram is given of the magnetic support circuit along with the various circuit interconnections required for normal operation. A.G.O.

N66-36771*# Hughes Research Labs., Malibu, Calif.
FOUR SPRING MOUNT ANALYSIS (2-D)
In its Res. on Gravitation al Mass Sensors [1966] 12 p (See N66-36766 22-14) CFSTI: HC $7.36/MF $2.25

A numerical analysis of a four spring structure devised for mounting a gravitational mass sensor head to the rotation mechanism is presented. The geometric arrangement for the four spring mount is shown, and it is pointed out that the sensor is pulled into circular motion by a rotating platform which is driven at constant angular speed. A vector diagram of restoring spring forces on the sensor is given, and the effective spring constant of the four spring sensor mount is graphed. Mathematical results indicate that instability occurs when the rotational frequency is just slightly larger than the effective four spring natural frequency. It is also reported, however, that experimental evidence revealed that the mount is stable for rotational speeds of several times the natural frequency. Several hypotheses are suggested to explain the apparent lack of correlation between the analysis and experimental results. A.G.O.

N66-36772*# Hughes Research Labs., Malibu, Calif.
PHASE SHIFT TUNED AMPLIFIER
In its Res. on Gravitational Mass Sensors [1966] 7 p (See N66-36766 22-14) CFSTI: HC $7.36/MF $2.25

A numerical analysis is presented for a phase shift tuned amplifier circuit in an idealized case using the metal oxide silicon field effect transistor (MOSFET). The MOSFET is ideal for this circuit because it has essentially infinite input resistance and operates with a forward bias equal to its drain voltage. The amplifier circuit is shown schematically in both the generalized and optimized form. The derived formulas describe the general circuit behavior and are useful for high current values. To verify the analytical study experimentally, a circuit with variable resistors was connected to a cruciform mass sensor. It is reported that the results showed high effective gain and strong coupling between mechanical and electrical resonant circuits. A.G.O.

N66-36773*# Hughes Research Labs., Malibu, Calif.
ROTATING TENSOR SENSORS
Robert L. Forward *In its* Res. on Gravitational Mass Sensors [1966] 10 p refs Presented at Am. Phys. Soc. Winter Meeting, Berkeley, Calif., 21–23 Dec. 1964 Submitted for Publication (See N66-36766 22-14) CFSTI: HC $7.36/MF $2.25

We have been investigating a novel class of differential force sensors which utilize the rotational properties of tensors in order to separate the effects of forces from the effects of the gradients of the forces. The basic concept is that tensors of n^{th} rank, when examined in the rotating reference frame of a sensor, will be found to produce time-varying signals that are at n times the rotational frequency of the sensor. Two applications, namely a gravitational mass sensor and a magnetic gradient sensor, are discussed. Work has started on a research model of the gravitational mass sensor. It is theoretically capable of distinguishing the gravitational effects of a nearby mass from the inertial effects of acceleration and rotation. The magnetic gradient sensor, recently constructed and tested, consists of two opposed coils attached to opposite sides of a rotating shaft and operates in such a manner that any gradient in a magnetic field produces currents at a frequency twice the rotation speed, while mechanical imbalances come out at the rotation frequency. Author

N66-36774*# Hughes Research Labs., Malibu, Calif. Theoretical Studies Dept.
ROTATING GRAVITATIONAL AND INERTIAL SENSORS
Robert L. Forward *In its* Res. on Gravitational Mass Sensors [1966] 7 p refs Submitted for Publication (See N66-36766 22-14) CFSTI: HC $7.36/MF $2.25

The tensor characteristics of the inertial fields created by acceleration and rotation and the gravitational fields created by masses are discussed. The inertial field created by acceleration is a uniform vector field and has no gradients, while the inertial field created by rotation has a uniform cylindrically symmetric tensor gradient but none of higher order. The gravitational field created by a mass is highly nonuniform with essentially no limit to the number of higher order gradients. These differences make it theoretically possible to measure independently gravitation, rotation, and acceleration effects; to do so, some form of differential force sensor with tensor response characteristics must be used. The technique used is dynamic; by rotation of the differential sensor, the static spatial variations are transformed into temporal variations with various frequency components. It is then possible to distinguish between the various fields by frequency filtering. Author

N66-36775*# Hughes Research Labs., Malibu, Calif. Theoretical Studies Dept.
MASS DETECTION BY MEANS OF MEASURING GRAVITY GRADIENTS

Curtis C. Bell, Robert L. Forward, and J. Roger Morris *In its* Res. on Gravitational Mass Sensors [1966] 21 p refs Presented at AIAA 2d Ann. Meeting, San Francisco, 26–29 Jul. 1965 Also published as AAIA Paper No. 65–403 (See N66-36766 22-14) CFSTI: HC $7.36/MF $2.25

The operation of a sensor in which the restoring spring forces are perpendicular to the centrifugal forces acting on the outer masses is analyzed numerically. The arms of the sensor are constrained to vibrate in the plane of rotation and in a tangential direction. Forces acting upon and within the sensor such as gravitational force input, centrifugal force input, and vibration force input are considered, and the sensor response is evaluated by use of free body digrams. Using the derived equations an output to be expected from the sensor is calculated. It is concluded that an ideal cruciform-shaped system of masses and springs using piezoelectric strain transducers for readout has the basic ability to measure the gravitational force gradient of a massive object and yet is insensitive to inertial vibrations induced through the support and drive mechanisms. A.G.O.

N66-36776*# Hughes Research Labs., Malibu, Calif.
VIBRATIONAL MODE BEHAVIOR OF ROTATING GRAVITATIONAL GRADIENT SENSORS
Robert L. Forward, John M. Richardson, Curtis C. Bell, and J. Roger Morris *In its* Res. on Gravitational Mass Sensors [1966] 40 p refs Submitted for Publication (See N66-36766 22-14) CFSTI: HC $7.36/MF $2.25

We are engaged in a program to design and construct a feasibility model of a gravitational mass sensor that uses a rotating resonant elastic system to detect the gravitational force gradient fields of the mass. As part of this program, we have carried out a detailed analysis of the vibrational mode behavior of a rotating cruciform shaped spring-mass system supported on a spring mount. The behavior of the sensor modes as a function of the design parameters and the rotation speed agrees well with data obtained from actual sensors used in the experimental portion of the work. This theory can aid in the design of optimum sensors and sensor mount structures. Author

N66-36777*# Hughes Research Labs., Malibu, Calif.
GENERATION AND DETECTION OF DYNAMIC GRAVITATIONAL GRADIENT FIELDS
Robert L. Forward and Larry R. Miller *In its* Res. on Gravitational Mass Sensors [1966] 28 p refs Presented at Am. Phys. Soc. Meeting, Minneapolis, 20–22 Jun. 1966 Submitted for Publication (See N66-36766 22-14) CFSTI: HC $7.36/MF $2.25

A generator of dynamic Newtonian gravitational force gradient fields was constructed and used as a signal generator to calibrate the response of the gravitational gradient detectors being developed in research work on gravitational mass sensors. The generator is mounted on an air bearing supported motor and rotated at a nominal speed of 44 rps (2640 rpm). The detector is a 12 cm diameter cruciform shaped structure which responds to 88 Hz gravitational gradient forces. Data taken with four different mass distributions varying from 0 to 1000 gm and separation distances varying from 4.8 to 12 cm agree well with theory, indicating negligible nongravitational coupling. The minimum dynamic gravitational gradient field observed during this test was 6×10^{-9} sec^{-2} or 0.0002 of the earth's gradient. The equivalent acceleration exerted on the sensor arms by this field was 3×10^{-11} g's. Author (TAB)

N66-36778*# Hughes Research Labs., Malibu, Calif.
NONIDEAL BEHAVIOR OF ROTATING GRAVITATIONAL MASS SENSORS
D. Berman Jun. 1966 *In its* Res. on Gravitational Mass Sensors [1966] 68 p refs (See N66-36766 22-14 CFSTI: HC $7.36/MF $2.25
(RR-354)

A mathematical model of a nonideal gravitational mass sensor was formulated from basic Lagrangian principles. The model was checked against existing sensor behavior theory by consideration of the simplified "ideal" case. Next, a special case of the nonideal sensor was studied, where the center of mass of the sensor was held constant. This case was of academic interest, because it offered basic insight into the coupling effect of sensor imperfections and the gravity signal. Finally, the general nonideal equations were computer mechanized. Typical results are presented which consist of a wide variety of external disturbances and sensor parameter values. Specific hardware design considerations were then studied and indicated the desirability of weak sensor-to-platform coupling and high manufacturing precision. Author

N66-36781*# Ohio State Univ. Research Foundation, Columbus. Antenna Lab.
THE MUTUAL INTERPRETATION OF ACTIVE AND PASSIVE MICROWAVE SENSOR OUTPUTS
W. H. Peake, C. H. Shultz, and R. L. Riegler 15 Jul. 1966 20 p refs *Its* Rept.-1903-3
(Contract NSR-36-008-027)
(NASA-CR-77987) CFSTI: HC $1.00/MF $0.50 CSCL 09F

The interpretation of surface characteristics from microwave sensor outputs alone is more effective when data is available from both active (radar) and passive (radiometer) sensors. Because the radiometer output is the convolution of the desired radiation temperature of the surface and the antenna pattern, it is first suggested that this instrumental bias be removed (a simple "bootstrap" method is outlined). An example is used to show that the correction is a significant one for current radiometer performance, and should be applied by those investigators wishing to make quantitative interpretations of apparent surface temperatures. Results are given for two series of measurements, made almost simultaneously with radar and radiometer sensors (at 10 GHz and 35 GHz) over well controlled terrain. In each case the data from one sensor is used to give a more detailed explanation of the output of the other, and the combined sensor outputs interpreted in terms of measurable surface characteristics. Author

N66-36803# Army Engineer Research and Development Labs., Fort Belvoir, Va.
A MOSSBAUER SPECTROMETER
Edward F. Allard Jun. 1966 9 p ref
(AD-634658) CFSTI: HC $1.00/MF $0.50

The theory and operation of a Mossbauer spectrometer are described, specifically for study of the microstructure of azides and picrates. TAB

N66-36804# CTS Corp., Elkhart, Ind. Research and Development Div.
PRODUCTION ENGINEERING MEASURE FOR SUBMINIATURE, TRANSISTOR TYPE POTENTIOMETERS Quarterly Progress Report, 1 Jan.–31 Mar. 1966
C. L. Holmes and D. C. Kinsey [1966] 13 p
(Contract DA-36-039-SC-85976E)
(QPR-19; AD-634975) CFSTI: HC $1.00/MF $0.50

The 300 controls tested in accordance with action II, technical action request no. 8, completed the testing required

during this reporting period. All controls tested on the moisture resistance specification passed all requirements satisfactorily. The 100 controls of the 25,000 ohm bushing mount style which were tested on the 25,000 cycle rotational life test had a few controls which exceeded the allowable plus or minus 3% change in resistance with a maximum change of 6.58%.
Author (TAB)

N66-36823# Navy Electronics Lab., San Diego, Calif.
THERMAL (INFRARED) RADIOMETERS AS INSTRUMENTS FOR NONDESTRUCTIVE RELIABILITY TESTING Research Report, Oct. 1965–Mar. 1966
R. M. Fraser 10 May 1966 29 p
(NEL-1377; AD-635607) CFSTI: HC $2.00/MF $0.50

Exploitation of radiometers for the reliability testing of monolithic integrated circuits requires a knowledge of the capabilities and limitations of these instruments. As a basis for the design, development, and evaluation of radiometer systems, graphs have been worked out which illustrate the interaction of the major design parameters and the system requirements. The graphs were obtained by an analysis of the thermal detection and display problems from an engineering viewpoint.
Author (TAB)

N66-36885# Naval Missile Center, Point Mugu, Calif.
OCEAN WAVE PROFILE RECORDER. AN OCEANOGRAPHIC INSTRUMENT TRANSPORTABLE BY HELICOPTER Technical Memorandum, Jun. 1963–Jun. 1964
E. B. Croson 11 Jul. 1966 63 p
(TM-66-33; AD-635887) CFSTI: HC $3.00/MF $0.75

The report describes the development, the design, and the operation of the portable ocean wave profile recorder (OWPR). The appendix is intended to serve as an operations and maintenance manual until such time that the operating and maintenance procedures are published as a separate document. The OWPR, launchable and retrievable with a helicopter, provides the user with an accurate means of monitoring and measuring ocean surface conditions. The OWPR data, which are recorded on a self-contained magnetic tape recorder and transmitted by a self-contained telemetry transmitter, may be reproduced to show a line graph of the ocean surface conditions; or the data may undergo a comprehensive mathematical analysis to show various wave structure characteristics. The OWPR may operate in any ocean, the only requirements being that the place chosen must be accessible by helicopter and that the water depth must be 150 feet or more.
Author (TAB)

N66-36971# Oak Ridge National Lab., Tenn.
SOME REMARKS ABOUT SCINTILLATION COUNTERS WITH THIN PLASTIC SCINTILLATORS FOR β-DOSIMETRY
G. Nentwig [1965] 7 p refs Transl. into ENGLISH from Kernenergie (Dresden), Vol. 8, Aug. 1965 p 481–484
(ORNL-TR-1093)

A study of the counting response of scintillation counting devices using thin plastic scintillators when irradiated with beta particles of different energies with special relation to the descriminating energy as well as knowing the dose deposed in tissue per particle as a function of energy showed that utilizing a plastic scintillator of a surface density of about 10 mg/cm^2 in connection with a discriminating level of about 50 kev makes it possible to measure the beta dose or dose rate early independently of the maximum energy of conventional beta emitters in the range of about 150 kev to at least 2.5 Mev.
Author (NSA)

N66-36998# Oak Ridge National Lab., Tenn.
RESOLVING TIME PROPERTIES OF NaI SCINTILLATORS
J. Braunsfurth and H. J. Koerner [1965] 24 p refs Transl. into ENGLISH from Nucl. Instr. Methods (Netherlands), v. 34, 1965 p 202–212
(ORNL-TR-838)

Delayed coincidence techniques were applied to investigate the resolving time properties of NaI and NaI(Tl) scintillators. Prompt resolution curves were measured as a function of energy loss in the scintillators and triggering levels of the coincidence system. Qualitatively the results can be described by the theory of Gatti and Svelto. The influence of photomultiplier noise on the time resolution is considered. The resolution obtained with 56 AVP photomultipliers and 38 mm × 25 mm NaI(Tl) scintillators was 0.08 ns (fwhm) with slopes of 90 ps for ^{60}Co energies. These values are improved by about 35% when unactivated NaI at 80°K is used.
Author (NSA)

N66-37019# Japan Atomic Energy Research Inst., Tokyo.
MULTI-ANODE 2π GAS FLOW COUNTER FOR LARGE AREA SOURCES
Akira Sekiguchi, Kikuzo Sakagami, and Yasushi Kawada (Tokyo Univ.) Feb. 1965 15 p Transl. into ENGLISH from Oyo Butsuri (Tokyo), v. 33, no. 5, May 1964 p 348–354
(NSJ-TR-35)

A multi-anode 2π gas flow counter for the absolute determination of the radioactivity of large-area sources 14 cm × 18 cm for one, is described. The cathode comprises two parallel brass plates, which are parts of the counter casing. Five 30 mm-spaced anode wires of stainless steel and 0.05 mmϕ are stretched in a plane parallel to and at 15.5 mm from the cathode plates. A large area source of up to several mm thickness is put on the lower cathode plate. Usually, methane gas is used as the proportional region counting gas. In the proportional region, the parallel plate type cathode has advantages over other types. Narrowing of the anode wire spacing does not improve the counter characteristics much. Even in the G-M region, the mutual interference of anode wires has no significant effect on the measurement.
Author (NSA)

N66-37149*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
TEMPERATURE CONTROL UNIT FOR SOUNDING ROCKET APPLICATIONS
Kerstin Fredga and Robert S. Lee Washington, NASA, Oct. 1966 13 p
(NASA-TN-D-3491) CFSTI: HC $1.00/MF $0.50 CSCL 14B

Sounding rocket experiments sometimes utilize instruments requiring very close temperature control. A device was designed to fulfill this type of temperature control requriement for an optical birefringent filter and did so successfully on board three Aerobee 150 sounding rockets. It utilizes solid-state circuitry with Peltier thermoelectric heat pumps for temperature control. The mechanical and electronic design of this device are discussed in detail as well as the laboratory and in-flight performance data.
Author

N66-37154*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
A NEW DESIGN APPROACH FOR WIDE-RANGE TEMPERATURE MONITORING AND COMPENSATING NETWORKS IN SCIENTIFIC SATELLITES
Warren R. Crockett Washington, NASA, Oct. 1966 20 p refs
(NASA-TN-D-3617) CFSTI: HC $1.00/MF $0.50 CSCL 20M

An analytical design method is presented for thermistor-resistance temperature monitoring and compensating networks, providing good linearity over wide temperature ranges. These networks have the advantages of design simplicity, low power operation, small physical size, and low cost. Net-

work equations are established in terms of a desired operating characteristic, and unknown network parameters are determined by means of a simultaneous solution of these equations. Author

N66-37167# Ballistic Research Labs., Aberdeen Proving Ground, Md.
PRECISION OF MEASUREMENT, ACCURACY AND PROCEDURES FOR DETECTING OUTLYING OBSERVATIONS
Frank E. Grubbs [1965] 15 p refs Presented at the Army Sci. Conf., West Point, N. Y., 14–17 Jun. 1966
(AD-634686) CFSTI: HC $1.00/MF $0.50

The terms "accuracy" and "precision" are defined, and it is pointed out that accuracy requires precision, but precision does not necessarily imply accuracy. Precision and accuracy are graphically represented, and the estimation of measurement precision is discussed. The problem of detecting outlying observations is analyzed, and guidlines to help experimenters account for these deviations are presented. Criteria for testing outliers are given, and several examples using statistical criteria are described. A.G.O.

N66-37168# Systems Research Labs., Inc., Dayton, Ohio.
A PROGRAMMABLE LOW ENERGY ELECTRON DIFFRACTION DEVICE Interim Scientific Report
A. G. Jackson, D. E. Floyd, and P. W. Bunce Wright-Patterson AFB, Ohio, ARL, Apr. 1966 20 p refs
(Contract AF 33(615)-1047)
(ARL-66-0067; AD-636162) CFSTI: HC $1.00/MF $0.50

A LEED device of the Faraday cage type has been constructed which is capable of being programmed to collect intensity data at predetermined colatitude and azimuth angles. The range of angles which can be programmed is 0 degrees to 360 degrees in azimuth and 0° to 80° in colatitude. By using a metal chamber, ruggedness and simplicity in construction is achieved. The device is flexible enough to allow for an increase in automation by using punch card type inputs and to allow for a simple modification to a display device. Use of rotary motion feedthroughs permits firm control over motion of the sample and collector.
Author (TAB)

N66-37201# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
A DEVICE FOR COMPENSATING THE LINEAR SHIFT OF AN IMAGE DURING OBLIQUE PHOTOGRAPHY WITH A SUCCESSIVE-FRAME AERIAL CAMERA
A. I. Sizov 19 May 1966 6 p Transl. into ENGLISH from RUSSIAN Patent No. 165374 (Appl. No. 873614/26-10, 30 Dec. 1963) 1 p
(FTD-HT-66-86; AD-635855) CFSTI: HC $1.00/MF $0.50

The object of the invention is a device for compensation of the linear shift of an image during oblique photography by a successive-frame aerial camera by means of sequential exposure of the zones of the frame, which are parallel to the principal horizontal plane of the photograph, containing a focal plane continuous action shutter, a two-wedge compensator and electric motor; and which is distinguished by the fact that for the purpose of fulfilling the required law of change of the rate of compensation along the field of the frame during uniform movement of all elements, the focal plane shutter is kinematically connected through the differential reducer with the electric motor of a two-wedge compensator. Author (TAB)

N66-37231# Utah Univ., Salt Lake City. Upper Air Research Labs.
DROPOUT PROBE TECHNIQUES FOR *IN SITU* MEASUREMENTS OF MISSILE PLUME OPTICAL RADIANCE CHARACTERISTICS Final Scientic Report, 1 Jul. 1963–30 Jun. 1965
D. A. Burt, K. G. Olsen, P. S. Selander, L. C. Howlett, and G. D. Allred Jan. 1966 363 p refs
(Contract AF 19(628)-3243; ARPA Order 363)
(UU-66-5; AFCRL-66-108; AD-635883) CFSTI: HC $5.00/MF $1.00

Droupout capsules incorporating instruments capable of measuring the optical proprties of missile plumes and the instrumentation to assist in determining the capsule's aspect within the plume were designed and developed. Experiments wherein the capsules were dropped from scientific passenger pods attached to Atlas and Titan II missiles through the plumes of the in-flight missiles were conducted. Eight capsules were constructed and seven have been flown. The capsule instrumentation, integration and description of operation, as well as two extentive sections dealing with methods of determining capsule aspect within the plume are discussed. Author (TAB)

N66-37250# Picatinny Arsenal, Dover, N. J. Engineering Sciences Lab.
CHARGED PARTICLE ACCELEROMETER
James H. Fahs Aug. 1966 36 p refs
(PA-TR-3301; AD-636155) CFSTI: HC $2.00/MF $0.50

An accelerometer has been proposed in which an electrically charged microscopic glass sphere acts as the proof mass. There is no electrode configuration capable of producing an electrostatic field in which such a proof mass may be contained in stable equilibrium; however, if an alternating field is produced by properly shaped electrodes, the average effect of the field on a charged particle will be to drive it toward an equilibrium position. The electric fields produced by electrodes of cylindrical shape are determined and compared with those produced by electrodes shaped like hyperbolas of revolution; and these in turn are compared with fields determined by a relaxation solution for an actual experimental configuration. The possible use of a device of this kind as an accelerometer is considered and a nomograph is presented by which theoretically possible performance characteristics may be determined. It is shown that, although an accelerometer might be produced using solely the electrodynamic containment of a charged particle, the performance would not be outstanding and more satisfactory results may be obtained by other means, relegating dynamic containment to a subsidiary role. Author (TAB)

N66-37262# Army Engineer Geodesy, Intelligence and Mapping Research and Development Agency, Fort Belvoir, Va.
INSTRUMENT FOR MEASURING ABSOLUTE ACCELERATION OF GRAVITY
Kenneth D. Robertson Jun. 1966 16 p refs
(RN-18; AD-636154) CFSTI: HC $1.00/MF $0.50

A method is presented for the determination of the absolute acceleration of gravity. A reflector, terminating one arm of an interferometer is allowed to drop in a vacuum chamber. The fringes generated as the reflector falls, together with precise timing equipment, may permit measurements to be made with an accuracy of one part in 10^7. Design criteria for the instrument are presented. Author (TAB)

N66-37263# Applied Physics Lab., Johns Hopkins Univ., Silver Spring, Md.
MINIATURE RECORDING OPTICAL PYROMETER
Maynard L. Hill, James M. Akridge, and Christian A. Keller May 1966 19 p refs
(Contract NOw-62-0604-c)
(TG-825; AD-636101) CFSTI: HC $1.00/MF $0.50

A miniature recording optical pyrometer, based on a photovoltaic diode, has been developed for measuring temperatures in the range 2000° to 6000°F in hypersonic environments where thermocouples are inadequate. The devices have a rapid response and a raw signal that is a suitable input for standard strip recorders. Author (TAB)

N66-37272*# Documentation, Inc., College Park, Md.
THE INTRODUCTION OF MICROFICHE FOR DISSEMINATING TECHNICAL INFORMATION IN THE UNITED STATES
Douglas S. Price May 1966 28 p
(Contract NASw-1315)
(NASA-CR-62032) CFSTI: HC $2.00/MF $0.50 CSCL 14E

The development of an economical, reproducible, and convenient flat microfilm format that can be used and enlarged on existing equipment is described. The microfiche format, virtually unknown in this country in 1961, was selected as the most feasible means of meeting NASA's specifications for an easily read microform unit that comprised a single report and permitted reproduction of both additional copies of the microform and original size reproductions of the report. Production of a 5×8 microfiche was initiated for NASA in 1962. Factors leading to the selection of size and reduction ratios, the use of diazo film as the sensitive medium, and the standardization of the microfiche format are discussed. The evolution of camera modifications, film processing, and make-up techniques for quantity production is described. Although there are still some technical problems remaining, the NASA Scientific and Technical Information Facility produced over 5 million high-quality microfiche of reports in 1965. The adoption of the 105×148 mm microfiche format standard by government and industry insures its continued, expanded use and provides a ready market for developers of microfiche equipment. Author

N66-37274*# Bellcomm, Inc., Washington, D. C.
LUNAR ORBITER PHOTOGRAPHIC DATA ANALYSIS FOR APOLLO LANDING HAZARD APPRAISAL
C. S. Sherrerd 27 Jul. 1966 60 p refs
(Contract NASw-417)
(NASA-CR-78176; TR-66-340-3) CFSTI: $2.50/MF $0.75 CSCL 14E

The Apollo program has need for the quantitative analysis of lunar orbiter photography. This report presents performance objectives for a computer-based system to assist in this analysis. The software performance is outlined in terms of function, data flow, and output products. Processing rates sufficient to meet the needs of the Apollo program can be achieved with newly available general purpose computers. It is recommended that the system be developed in two stages. A minimal system should be ready to process lunar orbiter data shortly after it becomes available. Then the capability of the system should be augmented to achieve the full performance objectives. The total effort required for software development to meet the objectives is of the order of 20 to 35 man years. In order to support the second stage of development, it is recommended that further engineering analysis be performed in the following areas: (1) data sampling strategy, (2) noise filtering, (3) calibration of the lunar photometric function, (4) hazard criteria, and (5) minimization of operating time. Author

N66-37306*# Massachusetts Inst. of Tech., Cambridge. Experimental Astronomy Lab.
ANALYTICAL AND EXPERIMENTAL INVESTIGATIONS OF LOW LEVEL ACCELERATION MEASUREMENT TECHNIQUES
Shaoul Ezekiel, Philip K. Chapman, and J. Thomas Egan Apr. 1966 144 p refs
(Grant NGR-22-009-080)
(NASA-CR-78050; RE-23) CFSTI: HC $3.00/MF $1.00 CSCL 14B

An investigation has been made of techniques for the measurement of acceleration in the range 10^{-6} to 10^{-9} g. In developing an experimental apparatus, the approach was to seek unconventional mechanizations of the various components of a simple, linear, single-axis accelerometer, with considerable emphasis on system compatibility and with explicit provision of a means for calibration of the instrument. The resultant design choices are briefly outlined. Problems encountered in the design of a superconducting (Meissner effect) test mass suspension are described, together with results obtained from a feasibility demonstration model of the suspension. A laser interferometer was developed for the displacement detector and design principles for such a device are discussed. Restoring forces are generated by means of small coils within the suspension, and calibration is effected by means of controlled radiation pressure. Author

N66-37343# Joint Publications Research Service, Washington, D. C.
THE PRODUCTION OF AUTOMATIC INSTRUMENTS AND EQUIPMENT
A. N. Gavrilov 8 Sep. 1966 55 p refs Transl. into ENGLISH from the publ. "Proizvodstvo Priborov i Sredstv Avtomatiki" Moscow, Knowledge Publishing House, 1965 p 3-48
(JPRS-37483; TT-66-33911) CFSTI: $2.00

The basic problems concerning the scientific and technical problems involved in producing automatic instruments and equipment are discussed. The technological bases of designing are identified, and illustrations are presented. It is pointed out that one of the most important problems is raising reliability and precision of production. The necessity of developing new materials and new processes is emphasized, and new metals and metallurgical techniques are reviewed. N.E.N.

N66-37359*# Bourns, Inc., Riverside, Calif.
[DESIGN, DEVELOPMENT AND FABRICATION OF AN ABSOLUTE-TYPE PRESSURE SWITCH] Final Technical Report, 1 Jul. 1965-30 Jun. 1966
K. W. Clark 30 Jul. 1966 23 p ref
(Contract NAS8-20501)
(NASA-CR-78169; N-471-12) CFSTI: HC $1.00/MF $0.50 CSCL 09A

Design and development of a calibratable pressure switch to operate between −420° and +165°F during 30.0 g peak sinusoidal vibration between 38 and 2000 cps is described. Theoretical and empirical information relevant to the design concept is correlated and applied to one example unit to obtain operational data. Although the instrument is operative between −320°F and room temperatures, the actuation/deactivation pressure differential is approximately 20% over the maximum allowed value. S.P.

N66-37378*# Smithsonian Astrophysical Observatory, Cambridge, Mass.

A CRITICAL SURVEY OF UPPER-ATMOSPHERE DENSITY MEASUREMENTS BY MEANS OF IONIZATION GAUGES
M. P. Friedman 15 Jul. 1966 27 p refs
(Grant NsG-87)
(NASA-CR-78226; SAO Special Rept.-217) CFSTI: HC $2.00/MF $0.50 CSCL 14C

A discussion is given of gauge measuring techniques, with specific consideration given to the Explorer 17 gauges and interpretation of their data. It is shown that the present "state-of-the-art" for vacuum gauges is such that it is difficult to make estimates of the accuracy of measurements made in the upper atmosphere. This is mainly because gauge calibrations for atomic oxygen have never been made. Also, interpretation of gauge readings of pressures caused by gas mixtures is quite difficult. It is recommended that the factor of 2 between gauge and drag determined densities should be described as a difference rather than a disagreement. C.T.C.

N66-37383# Ballistic Research Labs., Aberdeen Proving Ground, Md.
THE DEVELOPMENT OF A HIGH ACCELERATION TESTING TECHNIQUE FOR THE ELECTRONIC INSTRUMENTATION OF HARP PROJECTILE SYSTEMS
Spence T. Marks, James O. Pilcher, II, and Fred J. Brandon Mar. 1966 52 p refs
(BRL-MR-1738; AD-635782) CFSTI: HC $2.00/MF $0.50

A brief description of project HARP (High altitude research project) is given, and the acceleration testing requirements for the electronic instrumentation of the projectiles are stated. The accleration testing methods which have previously been employed are reviewed. A BRL project for the development of a statisfactory acceleration testing technique for this purpose is described, and test results are given. These test results are analyzed, and test criteria are established and evaluated. Author (TAB)

N66-37410*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
THE INSTRUMENT FUNCTION OF A DIAGONAL-MOTION WIDE-ANGLE MICHELSON INTERFEROMETER SPECTROMETER
William D. Johnston, III Jul. 1966 35 p refs
(NASA-TM-X-55560; X-622-66-335) CFSTI: HC $2.00/MF $0.50 CSCL 20F

A wide-angle Michelson interferometer with a larger field of view, greater resolution and fewer reflecting interfaces than in the conventional instrument is described. A working model was made of glass half-cubes for visible light. An expression is derived for the instrument function and a plot shows its dependence on the field of view. The instrument can be used as an interferometer spectrometer for wavelengths ranging from the visible to the far infrared, particular attention being given here to the 5 to 30 micron range. Resolutions below one wave number seem feasible. Author

N66-37475# European Space Research Organization, Paris (France).
IMAGE TRANSDUCERS FOR AN ORBITING ASTRONOMICAL TELESCOPE
J. D. Mc Gee (Imperial Coll. of Sci. and Technol.) Feb. 1966 20 p refs
(ESRO-SM-50) CFSTI: HC $1.00/MF $0.50

The advantages of operating an astronomical telescope in orbit (better seeing, detection of ultraviolet radiation, absence of sky glow) will be best exploited by using photoelectronic (as opposed to photographic) detectors. Unfortunately none of the tubes proposed so far were found satisfactory for space applications, owing to their insufficient sensitivity, capacitance or insulating properties. Recently, however, a tube was developed having the required qualities, e.g., a very wide range of spectral sensitivity, good image resolution and long integrating times. The two developments most urgently needed now are the extension of the spectral sensitivity towards the short uv wavelengths ($\lambda < 1050$Å) and the replacement of the present system of electromagnetic scanning and focussing by a purely magnetic one using permanent magnets.
Author (ESRO)

N66-37522*# Oak Ridge National Lab., Tenn.
ABSOLUTE EFFICIENCY MEASUREMENTS OF NE-213 ORGANIC PHOSPHORS FOR DETECTING 14.4- AND 2.6-MeV NEUTRONS
T. A. Love, R. T. Santoro, R. W. Peelle, and N. W. Hill Sep. 1966 47 p refs
(NASA Order R-104(1); Contract W-7405-ENG-26)
(NASA-CR-78398; ORNL-3893) CFSTI: HC $2.00/MF $0.50 CSCL 18D

The absolute efficiency of two organic scintillators for detecting 2.6- and 14.4-MeV neutrons was determined by the associated particle technique with the recoil particles from the D(d,n) ^{3}He and T(d,n) ^{4}He reactions. The output of the neutron detector was placed in coincidence with the helium recoil pulses, and the efficiency of the detector was obtained as the ratio of the coincidence counts to the helium recoil counts. Measurements were made as a function of the bias level of a tunnel diode driven by the current pulse from dynode 14 of a multiplier phototube and also as a function of a bias threshold on the total light output. The bias level was calibrated in terms of pulse height spectra resulting from interactions in the phosphors of gamma rays of various energies. The results given are for a detector system which included a 5-mm slab in front of the scintillator and a 3.3-cm Lucite light pipe. Results are given for specified fast-light thresholds and for total light thresholds above about 160-keV electron-equivalent. Author

N66-37559# Royal Greenwich Observatory, Herstmonceux (England).
THE CASSEGRAIN SPECTROGRAPH OF THE YAPP 36-INCH REFLECTOR AT HERSTMONCEUX
J. D. Pope, D. R. Palmer, and J. B. Alexander London, HMSO, 1966 17 p refs Roy. Obs. Bull. No. 118 HMSO: 2s 6d

The optical and mechanical design is described of a grating spectrograph giving dispersions of 40A/mm or 80A/mm, constructed for use with the 36-inch reflector. The performance of the instrument is assessed: its stability is such as to suggest that high-dispersion radial-velocity work might be done at the Cassegrain focus. Author

N66-37574*# New Hampshire Univ., Durham. Dept. of Physics.
AN ELECTRIC FIELD METER FOR ROCKET AND SATELLITE USE
Wentworth Edwards Potter (M.S. thesis) Sep. 1966 99 p refs
(Grant NsG-624)
(NASA-CR-78389; UNH-66-4) CFSTI: HC $3.00/MF $0.75 CSCL 09C

The evidence for the existence of electric fields in the ionosphere and magnetosphere is discussed. It is seen that the charge particle motions of the atmospheric dynamo system cause electric fields in the ionosphere while plasma convections produce electric fields in the magnetosphere. The auroral and electrojet current systems are studied in relation to the electric and magnetic fields. It is proposed to make, in

situ, measurements of these electric fields estimated to be 0.1 to 100 mv/m using a high impedance differential electrometer amplifier. A high impedance field effect electrometer amplifier has been designed, and a description of this as well as of a rocket experiment for measuring ionospheric electric fields is presented. The system will first be used on sounding rockets and later on satellites. A unique, unfurlable probe system will be used. The accuracy of the system is expected to be ±50% to ±5% for measurements of 10 to 100 mv. Author

N66-37597# Royal Aircraft Establishment, Farnborough (England).
THE MAGNETIC CALIBRATION OF A SKYLARK SOUNDING ROCKET
E. A. R. Anstey May 1966 43 p refs
(RAE-TM-SPACE-78) CFSTI: HC $2.00/MF $0.50

The procedures which should be adopted during the attitude calibration of a fluxgate magnetometer when installed in a Skylark sounding rocket are described. Information is given on the test site requirements and subsidiary equipment necessary for conducting these measurements. Errors introduced into the magnetometer by the nature of its environment are discussed and details are given of the computer program that is used to process the experimental results obtained. Author

15 MACHINE ELEMENTS AND PROCESSES

Includes bearings, seals, pumps, and other mechanical equipment; lubrication, friction, and wear; manufacturing processes and quality control, and reliability; drafting; and materials fabrication, handling, and inspection.

N66-36459# Joint Publications Research Service, Washington, D. C.
STUDIES IN ELECTRICAL DISCHARGE MACHINING OF HIGH-STRENGTH METALS AND ALLOYS
M. A. Lyapunov, Ye. L. Tsenta, and E. P. Yufa 19 Aug. 1966 26 p ref Transl. into ENGLISH from the book "Elektroimpul'snaya Obrabotka Vysokoprochnykh Metallov i Splavov" Kiev, Tekhn., 1965 p 127–143
(JPRS-37118; TT-66-33547) CFSTI: $1.00

CONTENTS:

1. ELECTRICAL DISCHARGE MACHINING OF SHAPED AND INTRICATE MACHINE COMPONENTS P 1–17 refs (See N66-36460 22-15)

2. ELECTRICAL DISCHARGE MACHINING OF TEST SPECIMENS FROM SUPER STRENGTH STEELS p 18–19 refs (See N66-36461 22-15)

N66-36460# Joint Publications Research Service, Washington, D. C.
ELECTRICAL DISCHARGE MACHINING OF SHAPED AND INTRICATE MACHINE COMPONENTS
In its Studies in Elec. Discharge Machining of High-Strength Metals and Alloys 19 Aug. 1966 p 1–17 refs (See N66-36459 22-15)
(JPRS-37118; TT-66-33547) CFSTI: $1.00

Several applications of electric or spark discharge machining are discussed. These include the machining of gas turbine blades and gas turbine rotor wheels, flow sheets for machining runners, and the fabrication of stainless steel steam turbine screens. R.N.A.

N66-36461# Joint Publications Research Service, Washington, D. C.
ELECTRICAL DISCHARGE MACHINING OF TEST SPECIMENS FROM SUPER STRENGTH STEELS
In its Studies in Elec. Discharge Machining of High-Strength Metals and Alloys 19 Aug. 1966 p 18–19 refs (See N66-36459 22-15)
(JPRS-37118; TT-66-33547) CFSTI: $1.00

The use of electric discharge machining to shape tensile and impact specimens from super strength steels is described. R.N.A.

N66-36590# Joint Publications Research Service, Washington, D. C.
ELECTRONIC TREATMENT OF MATERIALS, NO. 3, 1965
2 Sep. 1966 142 p refs Transl. into ENGLISH of Elektronnaya Obrabotka Materialov (USSR), No. 3, 1965 p 1–93 (JPRS-37414; TT-66-33842) CFSTI: $4.00

CONTENTS:

1. ELECTROSPARK MACHINING OF METALS I. N. Rubtsov p 1–24 refs (See N66-36591 22-15)

2. INVESTIGATION OF THE PROCESS OF METAL EROSION IN AN AIR MEDIUM A. I. Kruglov and E. M. Strygin p 25–31 refs (See N66-36592 22-15)

3. INVESTIGATION OF ELECTROEROSION PHENOMENA ON THE SURFACE OF A DOUBLE LAYER ELECTRODE I. G. Nekrashevich and I. A. Bakuto p 32–35 refs (See N66-36593 22-15)

4. ANALYSIS OF DEVICES FOR THE AUTOMATIC TRACING OF CONTOURS IN THE ELECTROSPARK TREATMENT OF METALS K. K. Gularyan p 36–61 refs (See N66-36594 22-15)

5. THE INFLUENCE OF TECHNOLOGICAL REGIMES OF MECHANIZED ELECTROSPARK ALLOYING ON THE QUALITY OF THE OBTAINED SURFACE Yu. N. Petrov, L. I. Dekhtyar', I. I. Safronov, and A. Ya. Beznosov p 62–68 refs (See N66-36595 22-15)

6. ELECTROCRACKING OF LIQUID ORGANIC RAW MATERIAL, REPORT 2 N. S. Pechuro and A. N. Merkur'yev p 69–88 refs (See N66-36596 22-06)

7. ON THE ROLE OF ELECTRICAL AND MAGNETIC FIELDS IN THE VITAL ACTIVITIES OF BIOLOGICAL SYSTEMS L. K. Chernova p 89–96 refs (See N66-36597 22-04)

8. ELECTRICAL METHODS OF EXTRACTING JUICES FROM VEGETABLE MATTER E. V. Reshet'ko and A. A. Mamakov p 97–104 refs

9. MODEL EFI-ELEKTRON MACHINE FOR THE ELECTROSPARK ALLOYING OF METALLIC SURFACES N. I. Lazarenko, S. P. Fusov, A. I. Korniyenko, N. K. Naumov, K. Ya. Krasnolob et al p 105–111 (See N66-36598 22-15)

10. CERTAIN NEW DESIGNS OF PRECISION ELECTROSPARK MACHINE TOOLS AND THEIR PARTS Ye. M. Levinson p 112–121 (See N66-36599 22-15)

11. ELECTROSPARK MACHINE TOOL MODEL 4531 p 122–124 (See N66-36600 22-15)

N66-36591# Joint Publications Research Service, Washington, D. C.
ELECTROSPARK MACHINING OF METALS
I. N. Rubtsov *In its* Electron. Treat. of Mater., No. 3, 1965 2 Sep. 1966 p 1–24 refs (See N66-36590 22-15) CFSTI: $4.00

The advantages of the electrospark method for processing semiconductor materials are assessed, and the substantial differences between the semiconductor monocrystal and the properties of metals are delineated. Electron diffraction anal-

yses and X-ray diffraction experiments were conducted to determine the size of the relief and disturbed layers when processing semiconductors by this technique. Experimental results are also presented on electrospark processing of germanium, silicon, arsenide, and gallium antimonide, with a thin slowly moving piece of wire used as the processing electrode. Processing took place in industrial kerosene, and deionized water with a specific resistance of 1 megohm/centimeter. Details are also given on studies to determine the influence of the material and the diameter of the processing electrode on the productivity of electrospark processing; data indicate that the highest productivity was achieved with a nickel wire electrode. Brief descriptions are included on a series of special installations developed in support of this technology. M.G.J.

N66-36592# Joint Publications Research Service, Washington, D. C.

INVESTIGATION OF THE PROCESS OF METAL EROSION IN AN AIR MEDIUM

A. I. Kruglov and E. M. Strygin *In its* Electron. Treat. of Mater., No. 3, 1965 2 Sep. 1966 p 25-31 refs (See N66-36590 22-15) CFSTI: $4.00

Experimental data are presented, based on a study of erosion traces forming under the influence of a condensed pulse discharge on steel electrode surfaces in air. A conventional relaxation generator with a capacitive energy accumulator was used for the two series of experiments. In one, the steel plate was connected to the positive pole of the pulse generator, and a copper wire positioned 0.8 to 1 mm above the surface of the plate served as the second electrode. The discharge occurred when the voltage necessary for the sparkover across the assigned gap was developed on the electrodes. In the second, the same copper wire was placed in a limiter tube made of quartz or porcelain. The end of the electrode was inside the insulating tube at a distance of 0.1 to 0.2 mm from its end. Steel disk samples, 60 mm in diameter and 4 mm thick, were used. Results confirm that the amount of erosion with a contactless pulse discharge occurring in air is rather limited in comparison with metal erosion due to pulse discharge in a liquid medium. M.G.J.

N66-36593# Joint Publications Research Service, Washington, D. C.

INVESTIGATION OF ELECTROEROSION PHENOMENA ON THE SURFACE OF A DOUBLE LAYER ELECTRODE

I. G. Nekrashevich and I. A. Bakuto *In its* Electron. Treat. of Mater., No. 3, 1965 2 Sep. 1966 p 32-35 refs (See N66-36590 22-15) CFSTI: $4.00

To verify the migrational theory of the electrical erosion of metals, experiments were conducted on the flat surface of an electrode consisting of two metal layers located so that the axis of the discharge is perpendicular to the plane of the border between the metals. The current, passing through the contact of the current conducting channel with the electrode surface, also passes through the metal layers. Copper plates, 0.02, 0.17, and 1 mm thick, were covered on one side with a thin layer of tin, under a layer of resin. A bimetallic ingot was obtained, and machined to the proper electrode size; the copper plate formed the upper working side. The opposite electrodes were iron rods, 8 mm in diameter, with one end ground to a cone with an angle of about 40°. The experiment was designed so that first the copper and then the tin were subjected to erosion. After a series of discharges the areas of erosion traces were measured with a microscope and a planimeter. Data indicate that a change in the copper plate thickness also resulted in erosion changes on the iron conical electrode which served as the cathode. M.G.J.

N66-36594# Joint Publications Research Service, Washington, D. C.

ANALYSIS OF DEVICES FOR THE AUTOMATIC TRACING OF CONTOURS IN THE ELECTROSPARK TREATMENT OF METALS

K. K. Gularyan *In its* Electron. Treat. of Mater., No. 3, 1965 2 Sep. 1966 p 36-61 refs (See N66-36590 22-15) CFSTI: $4.00

The basic electrotracing and phototracing systems for electrospark tracing treatment of metals are depicted, and several modifications to the devices are described. Examples showing the tracing of the template contours are given. The feasibility of constructing automatic tracing devices using automatic digital systems synthesis methods is discussed. A probability system of tracing contours of any complexity with monotonous change in the inclination angle of the tangent is examined in detail. With the aid of a synthesized device it was possible to trace templates and phototemplates of practically any form, and to process parts of any configuration on the corresponding electrospark installations. In order to trace the contours of templates with a monotonous changing inclination angle of the tangent, a self-adjusting device was synthesized, which automatically makes all the necessary switchovers. It was concluded that the electrotracing and phototracing systems, in combination with the devices described, are simpler than known systems of digital programmed control; their shortcoming is the need for a precise metal template or a phototemplate. M.G.J.

N66-36595# Joint Publications Research Service, Washington, D. C.

THE INFLUENCE OF TECHNOLOGICAL REGIMES OF MECHANIZED ELECTROSPARK ALLOYING ON THE QUALITY OF THE OBTAINED SURFACE

Yu. N. Petrov, L. I. Dekhtyar', I. I. Safronov, and A. Ya. Beznosov *In its* Electron. Treat. of Mater., No. 3, 1965 2 Sep. 1966 p 62-68 refs (See N66-36590 22-15) CFSTI: $4.00

To determine the effect of basic alloying conditions, experiments were conducted on a device permitting the mechanization of electrospark alloying of flat and round parts. Cylindrical parts of standardized 45 steel, alloyed with T1K6 brand electrodes were used. Consideration was given to the feed rate of the alloying electrode, the different number of revolutions of the parts being reinforced, the number of passes and the electrical parameters of the system creating different degrees of hardness and roughness of the produced surface, and changes in the dimensions of the part being treated. Results indicate that the number of passes by the alloying electrode, and the amount of working current exert the greatest effect on the degree of surface hardness and the dimensions of the part being processed. The number of revolutions by the part, and the electrode feed rate have a lesser effect. It was also found that surface roughness, depends very little on the various regimes of electrospark alloying. M.G.J.

N66-36598# Joint Publications Research Service, Washington, D. C.

MODEL EFI-ELEKTRON MACHINE FOR THE ELECTROSPARK ALLOYING OF METALLIC SURFACES

N. I. Lazarenko, S. P. Fusov, A. I. Korniyenko, N. K. Naumov, K. Ya. Krasnolob et al *In its* Electron. Treat. of Mater., No 3, 1965 2 Sep. 1966 p 105-11 (See N66-36590 22-15) CFSTI: $4.00

Technical and electrical characteristics of the processing regimes of the model EPI-Elektrom electrospark machine are reported. The machine tool is designed for altering the physical and chemical properties of metallic surfaces, and its operation is based on the capability of polar electric pulses to introduce various alloying elements into the metallic surface being treated, or of applying layers of certain materials to it. As a result, there is a substantial change in the initial properties of the surface layer of both ferrous and nonferrous materials: their hardness, resistance to wear, heat resistance, resistance to corrosion, and electrical properties. The electromagnetic vibrator, and the electronic circuitry are shown. R.LI.

N66-36598# Joint Publications Research Service, Washington, D. C.

CERTAIN NEW DESIGNS OF PRECISION ELECTROSPARK MACHINE TOOLS AND THEIR PARTS

Ye. M. Levinson *In its* Electron. Treat. of Mater., No. 3, 1965 2 Sep. 1966 p 112–121 (See N66-36590 22-15) CFSTI: $4.00

Electrospark machine tools for the machining of small diameter openings in small parts made of different metals and alloys are described. Specifically discussed are two machines, both with a capacity for machining holes with a smallest possible diameter of 0.02 mm. Technical characteristics and performance data for these machines are given. Stressed in the discussion are stability of the power supply and proper functioning of the feed regulator, since they decisively affect the accuracy of the machining. Two automatic feed regulators especially designed for precision operations are discussed in this connection; one is for use with medium power machines, the other for small machines. Technical details of the feed regulators are also given. Illustrations of all equipment are included. K.W.

N66-36600# Joint Publications Research Service, Washington, D. C.

ELECTROSPARK MACHINE TOOL MODEL 4531

In its Electron. Treat. of Mater., No. 3, 1965 2 Sep. 1966 p 122–124 (See N66-36590 22-15) CFSTI: $4.00

An electrospark machine tool for high precision machining of hard cermet alloy parts of any shape using a template is described. A slowly moving wire, which rewinds from one reel to another, is used as the electrode. It was found to be most effective when used for machining the working elements of flanking dies, some types of bending dies, form tools, and thread chasers. The advantages of the tool are listed as: the simultaneous machining of precisely mated parts out of single billet with strictly parallel edges and an evenly distributed gap; decrease in the amount of technological operations and the length of the production cycle; ability to use a cheaper and more readily available method. The technical characteristics of the machine tool are listed, and photographs are included to illustrate the machine and its products. L.E.W.

N66-36649# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.

ON THE METHOD OF INVESTIGATING THE SCALAR EFFECT OF CAVITATION EROSION

I. I. Varga, B. A. Chernyavskiy, and K. K. Shal'nev *In its* J. of Appl. Mech. and Tech. Phys. 16 Feb. 1966 p 233–252 refs (See N66-36628 22-23) CFSTI: HC $7.00/MF $1.75

An experiment was conducted with erosion during cavitation of a circular cylinder taking into account the basic parameters of hydromechanical modeling: scale numbers for dimensions of models, cavitation, and flow speeds. In the investigation of scalar effect of cavitational erosion, special attention was given to : (1) the accuracy of determi ning the flow speed of cavitational resistance, loss to erosion, erosion spaces; (2) the identity of stages of cavitation, and relative dimensions of the models; (3) the proper designation of duration of experiments. To avoid a wide margin of error, the experiments were set up over a wide range of speeds and for a large number of their variants. R.LI.

N66-36709*# Santa Clara Univ., Calif.

CONICAL PIVOT BEARINGS FOR SPACE APPLICATIONS

George G. Herzl *In* JPL 1st Aerospace Mech. Symp. [1966] 21 p refs (See N66-36691 22-31) CFSTI: HC $7.00/MF $2.00

Conical pivot bearing characteristics and performance are analyzed, and criteria for minimal torque design are presented. Contact loads are considered for the pivot axis position for which friction torque is maximal (horizontal) and minimal (vertical), and the friction torque is calculated. Contact pressure and area are discussed and a method of determining minimum allowable pivot tip radius is given. Both contact in spherical and conical region are included. N.E.N.

N66-36720# Eidgenossische Technische Hochschule, Zurich (Switzerland).

CUTTING SURFACE ROUGHNESS AS A TEMPORARY EVALUATION OF THE FINISH ON METALLIC INDUSTRIAL MATERIALS [DIE SCHNITTFLAECHENRAUHEIT ZUR KURZZEITIGEN BEURTEILUNG DER SCHLICHTBARKEIT METALLISCHER WERKSTOFFE]

Mohamed Osman Mohamed Osman (Ph.D. Thesis) 1965 12 p refs In GERMAN

(Rept.-3552) CFSTI: HC $4.00/MF $1.00

The cutting surface roughness resulting from cuts at right angles on a precision turning lathe is evaluated for the purpose of determining its suitability to serve as an instant criterion for judging the finishing potential of the material. A detailed description is given of measuring and test methods, cutting tool characteristics, material properties, and of the machines that were used during the experiments. Surface roughness under various conditions of cutting is analyzed. A single value for determining the roughness of the entire surface is derived. It was found that the test results are decisively affected by the following: micro-profile of the tool's cutting edge; properties of the material; properties of the coolant; and most important, cutting speed. Transl. by K.W.

N66-36769*# Hughes Research Labs., Malibu, Calif.

AIR BEARING ANALYSIS

In its Res. on Gravitational Mass Sensors [1966] 6 p (See N66-36766 22-14) CFSTI: HC $7.36/MF $2.25

The behavior of an air bearing system was analyzed to determine the necessary changes for eliminating vertical vibrations which were a source of high frequency noise. The objective of the investigation was to find a bearing which generated a minimum amount of high frequency electromagnetic, acoustic, and vibrational noise suitable for smoothly rotating gravitational mass sensor structures. A numerical analysis was performed on a simplified structural model assuming that: (1) all expansion processes were isothermal, (2) there is no pressure drop across the spotface area, and (3) all frictional losses are negligible. It is reported that a new air bearing stator was constructed with different dimensions based on the analysis conducted. A.G.O.

N66-36844# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.

A METHOD OF MAKING MESH FILTERS FROM MATERIALS AND ALLOYS

K. L. Chevashova 19 May 1966 6 p Transl. into ENGLISH from Russian Patent No. 134092 (Appl. No. 659186/22, 18 Mar. 1960) 2 p

(FTD-HT-66-189; AD-635828) CFSTI: HC $1.00/MF $0.50

The object of the invention is a method of making mesh filters from metals and alloys by selective anode etching, in solutions of hydrochloric acid or its salts, of initial billet from a foil obtained by rolling or by pressing and sintering metallic powders. To intensify the process and improve the quality of the mesh, electrolysis is conducted under conditions set forth in the disclosure. To obtain a mesh from metals and alloys that cannot be etched (for example, tungsten, molybdenum and tantalum) other metals (for example, zinc, cadmium, iron) that form structural components in the composition of the alloy that are soluble in the selected electrolyte are introduced into the composition of the initial billet. TAB

N66-36957# General Electric Co., Schenectady, N. Y. Knolls Atomic Power Lab.

FRICTION FACTORS FOR USE IN ANALYSIS OF JOURNAL BEARINGS WITH VORTEX-TURBULENT FLOW

R. J. Fritz 24 Feb. 1966 19 p refs

(Contract W-31-109-ENG-52)

(KAPL-M-6546) CFSTI: HC $1.00/MF $0.50

Friction factors were estimated for Couette turbulence occurring in long sleeve bearings. The estimates were based on pipe flow correlations and are shown to agree very well with Robertson's data using the roughness factor $\epsilon/D=0.0004$. It is predicted that a practical bearing will have significantly greater relative roughness. Friction factors are proposed for combined Reynold's (turbulent) and Taylor's (vortex) correlations assuming a roughness $\epsilon/D=0.004$ which is considered reasonable for a bearing surface of ASA roughness 10 and a radial bearing clearance of 5 mils. A proposal is made to estimate the friction factor for axial flow combined with rotational flow. These proposals are intended to apply to moderate bearing eccentricities, the range of which must be established by test. Author (NSA)

N66-36958# General Electric Co., Schenectady, N. Y. Knolls Atomic Power Lab.

SOME CONSIDERATIONS OF ROTOR DYNAMICS INCLUDING VIRTUAL MASS AND STABILITY EFFECTS

R. J. Fritz 24 Feb. 1966 23 p refs

(KAPL-M-M-6543) CFSTI: HC $1.00/MF $0.50

Bearing equations are derived for small deflections of a noncavitating, long-sleeve bearing, based on continuity and a turbulent form of the Navier–Stokes equation and including inertial terms. This bearing was shown to be inherently unstable. A virtual mass is calculated which agrees with the results of previous work for the case of no rotation and agrees with bearing theory for the case of half-frequency whirl. A dynamic system was considered which is intended to represent a tilted-pad bearing with displacement cross-coupling. The criterion for stability for this system was shown to depend on the degree of cross-coupling. Author (NSA)

N66-37006# Oak Ridge National Lab., Tenn.

DEVELOPMENT OF BONDING METHODS FOR GRAPHITE MATERIALS

Feb. 1965 47 p refs Transl. into ENGLISH of Japanese Atomic Energy Res. Inst. Rept. no. JAERI-1071

(ORNL-TR-670)

An account is given of bonding methods developed since 1959. (1) Brazing Materials. A new brazing material of Ni–Fe–Ti alloy was found for the bonding of graphite objects. On the other hand, a new type of brazing material, a paste, was also found. (2) Brazing Methods. Vacuum brazing, inert-gas-shielded arc brazing (Tig brazing), and resistance brazing were developed. The new techniques of reinforcement with metallic deposited beads and double-pass Tig brazing were also developed. (3) Bonding of Metallic Terminals on SiC Electric Heaters. In in-pile experiments, a SiC heater is suitable. A new process was found by which a titanium terminal can be bonded to a SiC heater with graphite as rink material. The terminals fabricated by this process are capable of using at 1000°C. NSA

N66-37144*# Westinghouse Electric Corp., Baltimore, Md.

SUPERIOR PHOTOENGRAVING PROCESS FOR SEMICONDUCTOR DEVICES

C. J. Taylor Washington, NASA, Sep. 1966 39 p refs

(Contract NAS5-2755)

(NASA-CR-597) CFSTI: HC $2.00/MF $0.50 CSCL 13H

An investigation of the preparation of a silicon wafer surface prior to the application of photoresist to improve the resist adhesion is reported. Several process variations for obtaining oxide surfaces are investigated and correlated with resist adhesion. Methods of mechanically and chemically conditioning the oxide-passivated surface of the wafer to improve the adhesion of resist are investigated. The effects of varying the resist coating thickness and the use of various chelating agents, wetting agents, and surfactants to find a linkage to bond the open chain-end of the resist to the surface of the oxide are studied. Procedures are evolved, and those used in the testing program are described. In this report, the use of Kodak metal etch resist as a silicon dioxide masking agent is investigated, and the effects of additives and of a new developer, as well as those of ambient variations are outlined and their importance described. Author

N66-37273*# Aerojet-General Corp., Sacramento, Calif.

FEASIBILITY STUDY OF ACOUSTIC DEPRESSURIZATION SYSTEM Final Report, 15 Jul. 1964–25 Feb. 1966

A. T. Green, C. S. Lockman, S. J. Brown, and R. K. Steele Mar. 1966 256 p refs

(Contract NAS7-310)

(NASA-CR-55472) CFSTI: HC $3.75/MF $1.50 CSCL 13H

Feasibility was demonstrated for a conceptual system utilizing the elastic waves transmitted from flaw growth in a rocket motor case to indicate potential failure and initiate remedial action to prevent destruction. Tests confirmed the ability to arrest flaw growth based upon recognition of a "critical stress-wave signature" and to locate the flaw in large rocket motor cases. Author

N66-37392# Marine Engineering Lab., Annapolis, Md.

GALVANIC CORROSION BEHAVIOR OF WEAR-RESISTANT MATERIALS FOR MECHANICAL SHAFT SEALS

D. C. Vreeland Jul. 1966 16 p ref

(MEL-242/66; AD-635592) CFSTI: HC $2.00/MF $0.50

Shaft seals currently used on submarines employ mating wear surfaces which are supported by Monel carrier rings. Galvanic corrosion effects between various candidate mating materials and Monel have been investigated by the exposure

of couples in seawater. The 14 materials exposed included seven cobalt-chromium alloys, six sintered carbide materials, and one copper-lead-tin alloy. The results indicate that galvanic coupling to Monel had no adverse effect on the corrosion behavior of five of the cobalt-chromium alloys, and one of the sintered carbide materials. Author (TAB)

N66-37524*# North American Aviation, Inc., Columbus, Ohio.
TEST AND EVALUATION OF ARTICULATING JAW ASSEMBLIES Final Report
H. R. Green 2 Sep. 1966 79 p
(Contract NAS8-20271)
(NASA-CR-78323) CFSTI: HC $3.00/MF $0.75 CSCL 13I

This report covers the assembly, installation, and testing of a set of articulating jaw assemblies on a stretch forming press. Performance of the jaw assemblies was compared to the jaws normally installed on the press. No significant differences were found between the two sets of jaws. Some recommendations concerning future jaw and stretch press designs have been included. Author

N66-37588# United Kingdom Atomic Energy Authority, Springfields (England).
SOME STATISTICAL TECHNIQUES FOR REDUCING THE NUMBER OF MEASUREMENTS DURING INSPECTION
D. Fenna 1966 23 p refs
(TRG-1200(S)) HMSO: 2s 6d

Assessment of the minimum number of measurements necessary to maintain a statistically defined quality is an important means of keeping down inspection costs. This report describes and assesses some of the most widely used sampling schemes. As an example, a simple sampling scheme is evolved which enables a specification and a set of inspection results to be fed into a Mercury computer program giving as output the required sampling scheme. Author

16 MASERS

Includes applications of masers and lasers. For basic research see: 26 Physics, Solid State.

N66-36554# Sylvania Electric Products, Inc., Waltham, Mass. Applied Research Lab.
PRECISION AUTOMATIC TRACKING USING A CW LASER
E. L. Mc Gann *In* Canaveral Council of Tech. Soc. 3d Space Congr. 1966 p 583-597 refs (See N66-36506 22-30)

The design and performance of a precision CW laser tracker are described. Its tracking accuracy against low acceleration targets is comparable to the accuracy of a star tracker, however, the laser tracker has the added capability of measuring range to the target. The main components in this tracking system are a servo-controlled flat mirror, a large aperture parabolic mirror, an image dissector, and manual control facilities. The laser source is a 10 milliwatt He-Ne gas laser. The instrument was used to track a retroreflector carried by a light airplane, a small rocket covered with Scotchlite retroreflective material, the Echo I satellite, and a +7.5 visual magnitude star. The characteristics of the tracker performance revealed by these tests are cited. H.S.W.

N66-36913# Advanced Kinetics, Inc., Costa Mesa, Calif.
STUDIES ON THE INTERACTION OF LIGHT AND PARTICLE BEAMS
R. W. Waniek et al 15 Mar. 1966 37 p refs
(Contract AF 49(638)-1359)
(AFOSR-66-1090; AD-635016) CFSTI: HC $2.00/MF $0.50

CONTENTS:

1. SUMMARY OF RESEARCH ACTIVITIES 3 p
2. FARADAY ROTATORS FOR HIGH POWER LASER CAVITIES R. W. Waniek and N. George (Calif. Inst. of Tech.) 12 p refs (See N66-36914 22-16)
3. THE INTERACTION OF MACROSCOPIC PARTICLES WITH COHERENT LIGHT BEAMS 16 p refs (See N66-36915 22-16)

N66-36914# Advanced Kinetics, Inc., Costa Mesa, Calif.
FARADAY ROTATORS FOR HIGH POWER LASER CAVITIES
R. W. Waniek and Nicholas George (Calif. Inst. of Tech.) *In its* Studies on the Interaction of Light and Particle Beans 15 Mar. 1966 12 p refs (See N66-36913 22-16) CFSTI: HC $2.00/MF $0.50

The large values of Faraday rotation obtained with the use of pulsed high field magnets are shown to be applicable to the control of laser cavities. Experiments are described in which high field magnets are operated up to 400 k Oe to introduce large rotations in short highly transparent optical media. With a ruby laser, interesting pulse enhancement and periodic equispaced output is observed and related to the switching rate of the field, typically 20 k Oe/μsec. Used with a crypto-cyanine shutter, it is found that either a single giant pulse or a well-spaced series of pulses can be obtained. These are synchronized with respect to the varying magnetic field with fractional microsecond accuracy. Author

N66-36915# Advanced Kinetics, Inc., Costa Mesa, Calif.
THE INTERACTION OF MACROSCOPIC PARTICLES WITH COHERENT LIGHT BEAMS
In its Studies on the Interaction of Light and Particle Beams 15 Mar. 1966 16 p refs (See N66-36914 22-16) CFSTI: HC $2.00/MF $0.50

The apparatus, theory, and procedures used to study the generation and impingement of a laser beam against a suspended population of macroscopic particles are discussed in detail. By means of specially shaped quadrupole fields, aluminum microspheres of 20μ diameter were injected and supported in a given volume for reasonable lengths of time. The interaction was detected in a drift tube where pick-up electrodes determined velocity and acceleration. The effect of localized evaporation induced in minute particles by an impinging beam of coherent light was calculated. The expected recoil velocities generated by the beam pressure compounded by the evaporation process were determined and the acceleration of the macroscopic particles was evaluated for a given duration of the vaporization process. Terminal velocities in excess of 10^5 cm/sec could be expected for masses of the order of 10^{-11} grams, or more, and diameters of the order of 10 to 100μ with energy densities in the field of a few joules/cm^3. L.E.W.

N66-37072# Applied Physics Lab., Johns Hopkins Univ., Silver Spring, Md.
THE OUTPUT POWER AND DURATION OF GENERATION OF A RUBY OPTICAL QUANTUM GENERATOR AS A FUNCTION OF THE PUMPING

R. I. Gintoft and A. M. Sarzhevskii 21 Jun. 1966 9 p ref Transl. into ENGLISH from Dokl. Akad. Nauk Belorussk. SSR, v. 9, no. 9, 1965 p 578–580
(Contract NOw-62-0604-c)
(TG-230-T479; TT-66-61808; AD-635889) CFSTI: HC $1.00/MF $0.50

The conditions required to obtain maximum output from a ruby laser as a function of pumping conditions was investigated experimentally for several values of the interferometer base. At minimum distance, the output increases with increased pumping, but at greater distances the output levels off and at still greater distances, it undergoes a maximum, all at the same pumping power. A mechanism is proposed to account for these effects. Author (TAB)

N66-37176# Hughes Research Labs., Malibu, Calif.
HIGH POWERED DIFFRACTION LIMITED RAMAN LASER Final Report, 15 May 1965–14 Apr. 1966
F. J. Mc Clung, D. H. Close, R. W. Hellwarth, and W. G. Wagner May 1966 65 p refs
(Contract Nonr-4849(00); ARPA Order 306; Proj. Defender)
(AD-636250) CFSTI: HC $3.00/MF $0.75

Problems associated with the realization of a high energy, highly coherent Raman laser have been investigated. Since the discovery that the self-focusing of pump radiation and scattered radiation is present in most laboratory Raman lasers and tends to spoil the coherence of the output, the nature and mechanisms of this self-trapping have been the primary objects of study in order that it might be prevented. Time resolved photographic studies have been made which show that the small filaments of self-trapped light in the pump beam persist for only a small fraction of the beam pulse duration and are sufficiently intense to resolve the apparent discrepancy between the average intensity and observed Raman gains. Time integrated photographic studies and photometric studies showed that only purely linearly polarized light preserves its polarization after self-trapping in CS_2 and nitrobenzene. Attempts to compare measured nonlinear indices for both circular and linear polarizations with those calculated for various mechanisms were frustrated by this instability in the propagation of circularly polarized light. The instability was explained qualitatively and indicates that electrostriction is not a dominant mechanism. A classical statistical mechanical calculation of the nonlinear index of a liquid (with no macroscopic density changes) showed that the local redistribution of molecules is generally important. This effect will cause perfectly symmetric molecules to have a significant nonlinear index. Author (TAB)

N66-37256# Applied Physics Lab., Johns Hopkins Univ., Silver Spring, Md.
CALCULATION OF A LASER MONOPULSE DURING INSTANTANEOUS SWITCH-IN OF AN INTERFEROMETER
A. M. Samson and V. A. Savva 17 Jun. 1966 12 p refs Transl. into ENGLISH from Dokl. Akad. Nauk Belorussk. SSR, v. 9, no. 1, 1965 p 22–26
(Contract NOw-62-0604-c)
(TG-230-T473; TT-66-61809; AD-635890) CFSTI: HC $1.00/MF $0.50

Formulas are derived for analyzing the basic characteristics of a single-pulse Q-switching laser as functions of population inversion, pumping power, mirror reflectivity, and other properties of the active medium and resonator. Calculations based on these formulas show good agreement with computations made on a digital computer in two previous works by the authors. The limits of applicability of the formulas are discussed. Author (TAB)

N66-37483# Stanford Univ., Calif. Microwave Lab.
MICROWAVE RESEARCH Quarterly Status Report No. 28, 1 Nov. 1965–31 Jan. 1966
M. Chodorow et al Apr. 1966 18 p refs
(ML-1424; AD-636090) CFSTI: HC $1.00/MF $0.50

Contents: Acoustic wave amplification studies, optical maser research, tunable lasers, geometrical optics of acoustic waves, oscillations in semiconductors, theory of nonuniform plasmas, bulk instabilities in ferromagnetic metals. TAB

17 MATERIALS, METALLIC

Includes cermets; corrosion; physical and mechanical properties of materials; metallurgy; and applications as structural materials. For basic research see: 06 Chemistry. For related information see also: 18 Materials, Nonmetallic; and 32 Structural Mechanics.

N66-36500# Eidgenossische Technische Hochschule, Zurich (Switzerland).
ON THE DEFORMATION OF METALS BY SHOOTING [UEBER DIE VERFORMUNG VON METALLEN BEIM BESCHUSS]
Georg Enzler (Ph.D. Thesis) 1965 95 p refs In GERMAN
(Rept.-3634) CFSTI: HC $3.00/MF $0.75

Permanent deformation effects on 4 mm thick iron, steel, or brass plates by projectile penetration were studied over a temperature range from 20°C down to −180°C, and at initial projectile velocities of 720 m/sec. It was found that the penetration impulse transferred qualitatively almost parallel to the quality coefficient of the target material; iron and steel plates had larger impulse values with decreasing temperatures, but brass plates showed almost no change in transferred impulse values down to −180°C. Macrodeformations in the near vicinity of the penetration hole varied for the different target plates; at normal temperatures, iron and steel plates showed crater like deformations that changed to an almost clean deformation-free perforation at the lowest temperature level. All metal plates exhibited an exterior layer of extreme microdeformation of less than 0.1 mm thickness, regardless of temperature. Transl. by G.G.

N66-36627# Atomic Energy of Canada, Ltd., Chalk River (Ontario).
ELECTRON PROBE MICROANALYSIS OF ALUMINUM-CLAD ZIRCALOY-2 SPECIMENS AFTER HEAT TREATMENTS AT 400°C AND 500°C
C. D. Williams and J. Baird May 1966 32 p refs
(AECL-2570) CFSTI: HC $2.00/MF $0.50

A study of kinetics of oxide dissolution and interphase formation in Al-ZrO_2-Zircaloy-2 systems was initiated. The specimens used were sections of Zircaloy-2 tube, oxidized and clad internally with aluminum by the hot die sizing technique, and had been subjected to a range of aging and cyling treatment at 400°C and 500°C. Examination of a number of these specimens showed that no significant reaction had occurred at 400°C, but oxide dissolution and intermetallic formation had occurred during treatments at 500°C. The rate of extension of the interdiffusion layer was similar to that predicted from experiments. Specimens subjected to thermal cycling treatments to 400° and 500°C showed no evidence of interdiffusion effects. Author

N66-36784# Defence Standards Labs., Maribyrnong (Australia).
DEFENCE STANDARDS LABORATORIES ANNUAL REPORT, 1964–1965
[1965] 50 p
CFSTI: HC $2.00/MF $0.50

Research activities in the fields of chemistry, physics, metallurgy, engineering, and to a limited extent in biochemistry and physiology are summarized. The study emphasis is placed on problems arising in the provision and use of defense materiel. Investigations in the following areas are included: chromium alloy properties, abrasions of metals, steel fracture, infrared and Raman spectroscopy, organic compound molecular structure, high alloy steel qualitative analysis, lasers, crystal structure, optical thin films, aircraft fuel tank protective coating, static charges in fabrics, ultra high-speed photography, marine corrosion, and closed circuit television in meter calibration. A.G.O.

N66-36828# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
ELECTROMETALLURGY OF NONFERROUS METALS Selected Articles
14 Jan. 1966 43 p refs Transl. into ENGLISH from Tr. Leningr. Inst. (Leningrad), no. 239, 1964 p 39–56, 70–81 (FTD-MT-65-193; TT-66-61687; AD-635276) CFSTI: HC $2.00/MF $0.50

CONTENTS:

1. INTERACTION OF ALUMINUM WITH CRYOLITE–ALUMINA MELTS M. M. Vetyukov p 1–23 refs (See N66-36827 22-06)

2. ON THEORY OF ELECTROLYTIC REFINING OF METALS IN MELTS WITH LIQUID ELECTRODES Yu. V. Baymakov p 25–38 refs (See N66-36828 22-17)

N66-36828# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
ON THEORY OF ELECTROLYTIC REFINING OF METALS IN MELTS WITH LIQUID ELECTRODES
Yu. V. Baymakov *In its* Electromet. of nonferrous Metals 14 Jan. 1966 p 25–38 refs (See N66-36826 22-17) CFSTI: HC $2.00/MF $0.50

A physical and chemical analysis is made of phenomena occurring at electrodes during the electrolysis refining of metals in fused salts with electrodes of liquid metal. The effect of equilibrium $M_1X+M_2 \rightleftharpoons M_2X+M_1$ on the processes occurring at the electrodes is shown. Also shown is the influence of diffusion kinetics on the flow of the electrochemical reactions at the cathode and anode. It was determined that the degree of impurity accumulation in the anode alloy, permitting a normal process, depends on the position of the refined metal and of metal impurity in the electrochemical series of potentials of salt decomposition, and on the current density at the anode. R.N.A.

N66-36840# Carnegie Inst., of Tech., Pittsburgh, Pa.
THE EFFECT OF RAPID AUSTENITIZING ON A NIOBIUM STEEL
Tatsumi Osuka and Harold W. Paxton 15 Jun. 1965 17 p refs
(Contract Nonr-760(14))
(AD-635628) CFSTI: HC $1.00/MF $0.50

The effect of short time austenitizing treatments on 0.21% carbon steel, with or without niobium additions has been investigated. A considerable refinement of ferrite grain size can be produced, causing thereby an enhancement of the yield strength and a lowering of the transition temperature. Author (TAB)

N66-36853*# National Aeronautics and Space Administration, Lewis Research Center, Cleveland, Ohio.
PRELIMINARY OBSERVATIONS OF THE ENHANCEMENT OF SUPERCONDUCTING CURRENT-CARRYING CAPACITY IN NIOBIUM THROUGH HYDROGEN TREATMENT
Robert J. Smith, Donald E. Hegland, and Patricia R. Kendziorski Washington, NASA, Sep. 1966 12 p refs
(NASA-TN-D-3638) CFSTI: HC $1.00/MF $0.50 CSCL 11F

Measurements of resistivity as a function of applied magnetic field at constant current and temperature and resistivity as a function of temperature at constant current and field were obtained for niobium below 20°K. The measurements were taken after annealing niobium at 1600°C and again after treating the annealed niobium with hydrogen in a 0.1 N sulfuric acid solution. The results show that the current-carrying capacity of the hydrogen-treated niobium is greater than four times that of annealed niobium. Author

N66-36863# Wayne State Univ., Detroit, Mich. Dept. of Metallurgical Engineering.
THE Ni_3Al ORDERING SYSTEM
Clark L. Corey and Bogdon Lisowsky Jun. 1966 30 p refs (Contract Nonr-4520(00))
(TR-1; AD-635697) CFSTI: HC $2.00/MF $0.50

Electrical resistivity, X-ray line positions, degree of order, and microstructures have been investigated for Ni–Al alloys near the Ni_3Al composition. The results indicate that Ni_3Al undergoes disordering between 1250°C and the M.P., also supersaturated gamma, produced in gamma+gamma' alloys by gas-quenching, is extensively ordered prior to gamma' (Ni_3Al) phase separation. The latter reaction, if not both, must follow the cooperative phenomena model. Shifts in line position as a function of quench-induced supersaturation are shown. Lattice parameters of equilibrium and non-equilibrium phases are given. Author (TAB)

N66-36885# Institute of Modern Languages, Inc., Washington, D. C.
RECENT DEVELOPMENTS IN THE FIELD OF HIGH-GLOSS ALUMINUM [NEUERE ENTWICKLUNG AUF DEM GEBIET DER ALUMINIUM-GLANZWERK-STOFFE]
E. Tragner and G. Kappel Ft. Belvoir, Va., Army Engr. Res. and Develop. Labs., Jul. 1966 17 p refs Transl. into ENGLISH from Aluminium (Germany), no. 36/5, May 1960 p 267–271
(Contract DA-44-009-AMC-1563(T))
(ERDL-T-1852-66; AD-635649) CFSTI: HC $1.00/MF $0.50

The reflectal materials for bright anodizing, made from 99.99% Al, have given excellent results in the most diverse applications with respect to gloss and reflectance; in recent times, however, attempts are being made for economic reasons, to replace these high-purity alloys by less pure and thus cheaper materials, e.g., on basis of Al 99.9 (remiral) or even 99.8/99.85. The improvement of the bright anodizing methods and the many years of experience gained by the processors of these materials have made such a replacement feasible. It must be remembered, however, that an increase in the impurity level makes the achievement of high, uniform gloss more difficult, particularly under actual production conditions, so that compromises with regard to the brightness characteristics, particularly for large, plane surfaces, must be accepted. Author (TAB)

N66-36899# Joint Publications Research Service, Washington, D. C.
STUDIES ON THE PROPERTIES, TREATMENT AND PRODUCTION OF TITANIUM ALLOYS
17 Aug. 1966 31 p refs Transl. into ENGLISH from RUSSIAN Periodicals
(JPRS-37076; TT-66-33505)

CONTENTS:

1. DEFORMATION RESISTANCE IN COLD ROLLING OF VT14, VT15, AND VT16 ALLOY STRIP I. M. Pavlov, S. F. Burkhanov, E. R. Shor, E. Ye. Osipov, and A. M. Chinenov p 1–4 (See N66-36900 22-17)

2. COMPARATIVE OXIDIZABILITY OF VT14, VT15, AND VT16 TITANIUM ALLOYS WHEN HEATED IN AIR M. V. Mal'tsev, L. N. Morozov, V. N. Moiseyev, Yu. N. Yefremov, and A. I. Khorev p 5–11 (See N66-36901 22-17)

3. HIGH-TEMPERATURE THERMOMECHANICAL TREATMENT OF THE BETA ALLOY IN THE Ti-Mo-Cr-Fe-Al SYSTEM N. V. Ageyev, S. G. Glazunov, L. A. Petrova, G. N. Tarasenko, L. P. Grankova, et al p 12–17 refs (See N66-36902 22-17)

4. HIGH-TEMPERATURE THERMOMECHANICAL TREATMENT IN THE PRODUCTION OF VT15 TITANIUM-ALLOY EXTRUDED PIPES S. T. Kishkin, S. G. Glazunov, A. I. Khorev, Yu. L. Rubin, and E. M. Shilina p 18–24 (See N66-36903 22-17)

N66-36900# Joint Publications Research Service, Washington, D. C.
DEFORMATION RESISTANCE IN COLD ROLLING OF VT14, VT15, AND VT16 TITANIUM ALLOY STRIP
I. M. Pavlov, S. F. Burkhanov, E. R. Shor, E. Ye. Osipov, and A. M. Chinenov *In its* Studies on the Properties, Treat. and Production of Titanium Alloys 17 Aug. 1966 p 1–4 Transl. into ENGLISH from Tsvetn. Metal (Moscow), no. 4, Apr. 1966 p 72–73 (See N66-36899 22-17) CFSTI: $2.00

Force measurements and deformation resistance calculations are presented for plated and non-plated strips, and recommendations for material production are given. In the course of rolling, measurements were made of the strip thickness and of the total metal rolling pressure in each pass. A comparison of the plastic properties of the test alloys of titanium has shown that the alloy V16 has the best technological properties. It is also established that strip plating provides protection against oxidation and mechanical damage, reduces considerably the deformation resistance, and also prevents cracking. A.G.O.

N66-36901# Joint Publications Research Service, Washington, D. C.
COMPARITIVE OXIDIZABILITY OF VT14, VT15, AND VT16 TITANIUM ALLOYS WHEN HEATED IN AIR
M. V. Mal'tsev, L. N. Morozov, V. N. Moiseyev, Yu. N. Yefremov, and A. I. Khorev *In its* Studies on the Properties, Treat. and Production of Titanium Alloys 17 Aug. 1966 p 5–11 Transl. into ENGLISH from Izv. Vysshikh Uchebn. Zavedenii, Tsvet. Met. (Dzaudzhikau), no. 2, 1966 p 142–146 (See N66-36899 22-17) CFSTI: $2.00

All of the titanium alloys were subjected to effective hardening heat treatment, and the oxidizability was evaluated quantitatively from the weight increase of the specimens per unit of surface. The rate of oxidation up to 900°F is comparatively small for all the alloys, but intensive oxidation is observed starting with 1000°F. In comparing the results of the study for alloys with an α+beta-structure (VT14 and VT16 alloys) and a pure beta-phase (VT15 alloy), it is noted that the VT15 alloy, starting with the temperature of 1000°F, is oxidized approximately twice as intensively. Photomicrographs of the alloys indicate also that the gas diffusion into beta-titanium is of a selective nature, preferably along the boundaries of the grains. A.G.O.

N66-36902# Joint Publications Research Service, Washington, D. C.
HIGH-TEMPERATURE THERMOMECHANICAL TREATMENT OF THE BETA ALLOY IN THE Ti-Mo-Cr-Fe-Al SYSTEM
N. V. Ageyev, S. G. Glazunov, L. A. Petrova, G. N. Tarasenko, L. P. Grankova et al *In its* Studies on the Properties, Treat. and Production of Titanium Alloys 17 Aug. 1966 p 12–17 refs Transl. into ENGLISH from Metalloved. i Term. Obrabotka Metal. (Moscow), no. 5, 1966 p 12–14 (See N66-36899 22-17) CFSTI: $2.00

Alloy ingots were heated in an electric furnace and cold-rolled with various degrees of deformation. Mechanical properties of the alloy were compared as functions of deformation degree and rolling temperature. It was found that the best combination of strength and plasticity is observed in the alloy that has been subjected to high temperature treatment at 850°C with a degree of deformation of 60 to 80%, and aged at 500°C for 10 hours and at 525°C for 5 hours. Microstructure studies of the alloy, aged under the same conditions, but at different rolling temperatures, has shown that the α-phase, which has separated in the deformed beta-grains, has approximately the same grain size. A.G.O.

N66-36903# Joint Publications Research Service, Washington, D. C.
HIGH-TEMPERATURE THERMOMECHANICAL TREATMENT IN THE PRODUCTION OF VT15 TITANIUM-ALLOY EXTRUDED PIPES
S. T. Kishkin, S. G. Glazunov, A. I. Khorev, Yu. L. Rubin, and E. M. Shilina *In its* Studies on the Properties, Treat. and Production of Titanium Alloys 17 Aug. 1966 p 18–24 Transl. into ENGLISH from Izv. Akad. Nauk SSSR, Metally (Moscow), no. 3, 1966 p 125–129 (See N66-36899 22-17) CFSTI: $2.00

The technology of titanium alloy semifinished products deformed at high temperatures is considered. Results of mechanical tests on the pipe material after hot extrusion with cooling in air and in water are discussed, and properties of specimens hardened directly after extrusion by aging are shown. It is concluded that high temperature treatment makes it possible to considerably increase the mechanical properties of hot-deformed semifinished products of the VT15 alloy. Particularly significant effects are observed in the aged stats, and frequency curves show the lower level of mechanical properties are 15–20 kg/mm^2 higher, while plasticity is 3–6 times higher than for the alloy subjected to standard conditions of treatment. A.G.O.

N66-36918# National Academy of Sciences—National Research Council, Washington, D. C. Materials Advisory Board.
SUMMARY REPORT OF THE REFRACTORY METALS SHEET ROLLING PANEL Final Report, Jun. 1965–Dec. 1965
Jun. 1966 23 p refs
(Contract DA-49-083-OSA-313)
(MAB-212A-M; AD-636180) CFSTI: HC $1.00/MF $0.50

The method of operation, accomplishments, and recommendations of the panel are outlined (summarizing the contents of mab-212-m, 'final report of the refractory metals sheet rolling panel'). Author (TAB)

N66-36926*# Massachusetts Inst. of Tech., Cambridge. Dept. of Metallurgy.
RESEARCH ON MECHANISMS OF ALLOY STRENGTHENING Semiannual Report

Jun. 1966 13 p
(Grant NsG 117-61)
(NASA-CR-77719) CFSTI: HC $1.00/MF $0.50 CSCL 11F

CONTENTS:

1. ALLOY STRENGTHENING BY FINE OXIDE PARTICLE DISPERSIONS 5 p (See N66-36927 22-17)
2. THE SPLAT COOLING PROCESS FOR ALLOY DEVELOPMENT 5 p (See N66-36928 22-17)

N66-36927*# Massachusetts Inst. of Tech., Cambridge.
ALLOY STRENGTHENING BY FINE OXIDE PARTICLE DISPERSIONS
In its Res. on Mech. of Alloy Strengthening Jun. 1966 5 p
(See N66-36926 22-17) CFSTI: HC $1.00/MF $0.50

Progress is reported in studies of modes of deformation and fracture in oxide dispersed metal systems; oxide dispersion strengthened Fe-BeO alloys; oxide dispersion strengthened Cu-Al_2O_3 alloys by the SAP technique; chromium oxide control in oxidation resistant oxide dispersion strengthened alloys; and internal oxidation of dilute nickel base alloys. The investigations include mechanical property tests, electron microscopy, and metallographic studies. H.S.W.

N66-36928*# Massachusetts Inst. of Tech., Cambridge.
THE SPLAT COOLING PROCESS FOR ALLOY DEVELOPMENT
In its Res. on Mech. of Alloy Strengthening Jun. 1966 3 p
(See N66-36926 22-17) CFSTI: HC $1.00/MF $0.50

To produce fine metal powder in various particle size ranges directly from the melt, a continuous cycle, shock wave generator was built. Its working principle is described. It was found that the solid solubility of Si in Al can be increased from 1.6 atomic percent Si (at the eutectic temperature) to about 11 atomic percent Si (at room temperature) by employing the splat cooling method of rapid quenching from the liquid state. Foils of a Pb-Sn alloy were extruded into a wire of .125 inch diameter. Tests were made on this alloy, after aging at room temperature for four weeks, showed local elongations of 300%. It is reported that this approaches the range of superplasticity, and that sound specimens can be made from splat cooled Pb–Sn alloys. H.S.W.

N66-36982# Ohio State Univ. Research Foundation, Columbus.
A STUDY OF THE MECHANISM OF STRESS CORROSION CRACKING IN THE IRON-NICKEL-CHROMIUM ALLOY SYSTEM Quarterly Report, Dec. 17, 1965–Mar. 16, 1966
R. W. Staehle 28 Apr. 1966 37 p
(Contract AT(11-1)-1319)
(COO-1319-39) CFSTI: HC $2.00/MF $0.50

Work on installing a source of high-purity water was completed. A preliminary study of the effect of specimen surface preparation on time to breaking suggested that the explanation for the wide range of the data may lie in the nature of the passive film. The effect of boiling $MgCl_2$ on time to breaking of various alloy compositions is being studied for subsequent comparison with results from circulating autoclave studies. Information from boiling $MgCl_2$ studies showed cracking in commercial alloys at nickel contents as high as 55%. Thin foils of iron were exposed to boiling $MgCl_2$ with the result that stressed foils exhibited dissolution patterns that suggest preferential dissolution in regions through which mobile dislocations passed. This finding was similar to the results for pure nickel and various ternary alloys. Author (NSA)

N66-36991# Oak Ridge National Lab., Tenn.
EVALUATION OF NIOBIUM-VANADIUM ALLOYS FOR APPLICATION IN HIGH-TEMPERATURE REACTOR SYSTEMS
T. K. Roche, comp. Oct. 1965 34 p refs
(Contract W-7405-ENG-26)
(ORNL-TM-1131) CFSTI: HC $2.00/MF $0.50

Alloys in the Nb–V system were evaluated for potential use in high-temperature reactor systems capable of long-time operation. These alloys were attractive because of their good tensile properties as reported by other investigators. Properties of immediate interest that were examined included fabricability, corrosion behavior in Li, strength, weldability, aging response, and stability in high vacuums. The greatest emphasis was placed on alloys with about 40% V and small additions of Ti and Zr. This concentration of V has been shown to be near optimum for good tensile properties. A complete evaluation of the alloys was not carried out because several drawbacks were uncovered early in the program. For example, difficulty was experienced in fabricating seamless tubing of the alloy Nb–39% V–1% Ti, and this same alloy was subject to metal losses by evaporation at elevated temperatures in high vacuums. The most disappointing result was the lack of creep strength at elevated temperatures. This report presents the results obtained to justify the conclusion that other Nb alloys presently available would be more satisfactory for this application. Author (NSA)

N66-37001# United Kingdom Atomic Energy Authority, Harwell (England). Research Group.
TWIN FORMATION IN LAMELLAR PEARLITE
M. Proeger May 1965 4 p refs Transl. into ENGLISH from Natriwiss. (W. Berlin), v. 52(3), no. 57, 1965
(NP-TR-1306)

Mechanical twinning is briefly discussed. Illustrations are presented for (1) twinning across sheets induced by ferrite twins, (2) twins at a small angle to the sheets, (3) twins in granular pearlite, showing no kink bands, and (4) twins in the ferrite sheet. L.E.W.

N66-37002# Oak Ridge National Lab., Tenn.
NEW METHOD OF PREPARING LARGE ZIRCONIUM CRYSTALS
Marc Billion and Jean-Paul Langeron 16 Aug. 1965 4 p refs Transl. into ENGLISH from Compt. Rend. Acad. Sci. (Paris), v. 260, 1965 p 152–154
(ORNL-TR-783)

In the case of zirconium of sufficient purity, it is possible to prepare large crystals by the changing phase method: the transformation isotherm $\beta \rightarrow \alpha$ is displaced along the sample at a speed of 1 cm/hr. The crystals thus obtained possess a marked substructure. Author (NSA)

N66-37009# United Kingdom Atomic Energy Authority, Harwell (England). Research Group.
ELECTRON MICROSCOPE OBSERVATION OF SINGLE-CRYSTALLINE BERYLLIUM THIN FOILS [OBSERVATION DE LAMES MINCES MONOCRISTALLINES DE BERYLLIUM EN MICROSCOPIE ELECTRONIQUE]
Jacqueline Antolin, Jean-Paul Poirier, and Jean-Michel Dupouy 1965 52 p refs Transl. into ENGLISH of Comm. a l'Energie Atomique Rept. CEA-R-2789, 1965
(NP-TR-1383; CEA-R-2789)

Thin foils prepared from single crystalline beryllium samples deformed at room temperature, were observed by transmission electron microscopy. The various deformation modes were

investigated separately from their early stages and their characteristic dislocation configurations were observed. Basal slip is characterized at the outset by the presence of numerous dipoles and elongated prismatic loops. More pronounced cold work leads to the formation of dislocation tangles and bundles which eventually give a cellular structure. Prismatic slip begins by the cross-slip of dislocations from the basal plane into the prismatic plane. A cellular structure is equally observed in heavily deformed samples. Sessile dislocations were observed in twin boundaries; they are pronounced by reactions between slip dislocations and twin dislocations. Finally, the study of samples quenched from 1100°C and annealed at 200°C showed that the observed loops lie in prismatic planes and have a Burgers vector $\vec{b}=1/3(11\bar{2}0)$. Author (NSA)

N66-37011# United Kingdom Atomic Energy Authority, Harwell (England).

THE RATE OF SINTERING OF URANIUM DIOXIDE POWDER UNDER OXIDIZING AND REDUCING CONDITIONS AND CONSEQUENCES CONCERNING THE RELEASE OF FISSION PRODUCT GASES (RARE GAS DIFFUSION IN SOLIDS 16)

P. Moeller and K. Wagener Sep. 1965 19 p refs Transl. into ENGLISH from Nukleonik (Heidelberg), v. 7, no. 3, Mar. 1965 p 113–117 3.

(NP-TR-1355)

When testing nuclear fuel containing uranium by Post-Activation-Diffusion-(PAD)-measurements, the neutron-irradiated samples are usually annealed either in a vacuum or an inert gas atmosphere. By this treatment measurable quantities of fission rare gases can be obtained. During this procedure, the uranium dioxide samples usually are not in equilibrium with the oxygen partial pressure. Therefore they are oxidized or reduced, respectively, depending on the test conditons. Thermo-gravimetric tests and specific surface measurements on uranium dioxide powder indicate that during a change of the oxygen/uranium ratio, the sintering is markedly accelerated. This fact leads to the hypothesis that increased mobility of the lattice ions accelerates the release of the rare gas. In this way the bursts in the rare gas release—often observed in PAD-measurement—can be interpreted. Author

N66-37031*# National Aeronautics and Space Administration, Lewis Research Center, Cleveland, Ohio.

MECHANICAL PROPERTIES OF DILUTE TUNGSTEN-RHENIUM ALLOYS

William D. Klopp, Walter R. Witzke, and Peter L. Raffo Washington, NASA, Sep. 1966 38 p refs

(NASA-TN-D-3483) CFSTI: HC $2.00/MF $0.50 CSCL 11F

Tungsten alloys containing 1.9 to 9.1 weight percent rhenium and 1 to 7 percent rhenium were prepared by electron beam and arc melting, respectively. These were warm fabricated into sheet and/or rod and evaluated by low temperature bend and tensile studies, high-temperature tensile and creep studies, and recrystallization and grain growth studies. The dilute tungsten-rhenium alloys were significantly more ductile than unalloyed tungsten. The dilute arc melted alloys were slightly less ductile than the electron beam melted alloys, and room temperature ductility was observed only with the 1.0 percent rhenium alloy. Annealing at 3600°F recrystallized all the alloys and significantly increased the bend transition temperatures. At 2500° to 3500°F, the short-time tensile strength increased with increasing rhenium content up to 9.1 percent rhenium. The creep strength at 3500°F increased with increasing rhenium content up to 5 to 7 percent rhenium. The 24- and 26-percent-rhenium alloys were weaker than the dilute alloys and had about the same creep strength as unalloyed tungsten. Author

N66-37039*# Pratt and Whitney Aircraft, East Hartford, Conn.

DETERMINATION OF THE EMISSIVITY OF MATERIALS Semiannual Progress Report, 15 Nov. 1965–14 May 1966

W. J. Walek, W. L. Luoma, and R. C. Emanuelson 30 Jun. 1966 88 p refs

(Contract NAS3-4174)

(NASA-CR-72058; PWA-2877) CFSTI: HC $2.50/MF $0.75 CSCL 11F

Analyses of titanate coated niobium–1% zirconium and stainless steel tubes, and of titanate coated beryllium plates are reported. Details are presented on the test methods. For the iron titanate coated Nb–Zr tube, emittance values of 0.88 to 0.84 were obtained, and a limited amount of diffusion was noticed. The substrate was found to be partially recrystallized, and an increase in hardness was attributed to oxygen and coating diffusion. The aluminum oxide–aluminum titanate coated Nb–Zr tube test showed that the coating deteriorated and is not suitable for space radiator use. Analysis of titanate coated beryllium plates showed that the coatings had adequate adherence and compatibility with beryllium for 1000 hours at 1200°F, and that aging produced no changes in the coatings or substrates other than permanently increasing the emittance of calcium titanate to 0.92. N.E.N.

N66-37066# Franklin Inst., Philadelphia, Pa. Research Labs.

LIQUID METAL EMBRITTLEMENT Final Report, Sep. 1, 1965–Mar. 31, 1966

R. N. Orava Apr. 1966 32 p refs

(Contract Nonr-4225(00))

(F-B2119-2; AD-633018) CFSTI: HC $2.00/MF $0.50

Microstrain and etching experiments were conducted on 70/30 brass single crystals to determine the effect of the presence of liquid mercury at the surface on deformation characteristics in the early stages of plastic flow. It was revealed that dislocations become mobile at stresses as low as 0.04 $kg.mm^{-2}$ in annealed crystals, a sharp contrast to previous observations. A model is presented to explain the microstrain characteristics. A debris layer near the surface was observed to a depth of about 20 microns after 2×10^{-3} plastic shear strain, irrespective of the presence of mercury. Thus, liquid mercury is equally as effective as an oxide film in impeding the emergence of dislocations from a crystal. Since the degree to which this type of behavior inhibits crack relaxation could not be determined, it was not possible to rigorously establish this as the mechanism for liquid metal embrittlement. Author (TAB)

N66-37137*# Israel Program for Scientific Translations, Ltd., Jerusalem.

METALLURGY OF RARE METALS

A. N. Zelikman, O. E. E. Krein, and G. V. Samsonov 1966 544 p refs Transl. into ENGLISH of "Metallurgiya Redkikh Metallov" Moscow, Izd. Met., 1964 Published for NASA and NSF

(NASA-TT-F-359; TT-65-50137; IPST-1455) CFSTI: HC $5.93/MF $2.75 CSCL 11F

A textbook is presented for students specializing in the metallurgy of the rare metals. In describing the metallurgy of each metal, much emphasis is placed on its physicochemical nature and the practical operations involved in the main technological processes for the production of its chemical compounds and of the pure metal. Individual chapters are included for tungsten, molybdenum, tantalum and niobium, titanium, zirconium, rare-earth metals (lanthanides), germanium, gallium, indium, thallium, rhenium, beryllium, and lithium. A.G.O.

N66-37164# Air Force Systems Command, Wright-Patterson AFB, Ohio. Air Force Materials Lab.
YCo_5—A PROMISING NEW PERMANENT MAGNET MATERIAL Research Report, Jul.–Dec. 1965
Karl J. Strnat and Gary I. Hoffer May 1966 41 p refs
(AFML-TR-65-446; AD-484670)

The magnetic characterization of the yttrium–cobalt compound YCo_5 was completed by a measurement of the crystal anisotropy constants. The results are analyzed and the conclusion is drawn that YCo_5 is a new permanent magnet material which promises to surpass the energy product of the best magnets now available by a factor of three. First experimental results are presented which support this hope. The preparation of the alloy, its pertinent properties, and a production method for fine particle magnets are described. The technological and economic aspects of the new substance are discussed in comparison with other permanent magnet materials. It compares favorably in all respects except price. Possible modifications which will substantially reduce the cost are proposed and future work plans outlined. The discussion of YCo_5 is preceded by a review of the present state of permanent magnet development, and those results of the theory of fine particle magnetism and permanent magnets which are necessary to understand the ensuing arguments.
Author (TAB)

N66-37194# Naval Air Engineering Center, Philadelphia, Pa.
THE ROLE OF OXYGEN IN THE BRITTLE BEHAVIOR OF METALS Thirteenth Progress Report, 1 Jul. 1965–31 Mar. 1966
Edwin S. Tankins 21 Jun. 1966 84 p refs
(NAEC-AML(9)-R360FR101; AD-636152) CFSTI: HC $3.00/MF $0.75

Contents: an examination of Henry's law in liquid metal systems with infinitely dilute solutions of oxygen; the thermodynamic properties of dilute solutions of oxygen in the liquid binary cobalt-copper alloys; the thermodynamic behavior of oxygen in liquid binary-metallic solvents—a simple solution model; the thermodynamic properties of dilute solutions of oxygen in the liquid binary Cu–Ni alloys.
TAB

N66-37199# Institute of Modern Languages, Inc., Washington, D. C.
ON THE FORMATION OF OXIDE FILMS ON ALUMINUM
W. Kaden Ft. Belvoir, Va., Army Engr. Res. and Develop. Labs., Jun. 1966 31 p refs Transl. into ENGLISH from Aluminum (Germany), No. 39, 1963 p 33–41
(Contract DA-44-009-AMC-1563(T))
(T-1849-66; TT-66-61785; AD-635687) CFSTI: HC $2.00/MF $0.50

Aluminum specimens provided with different types of oxide films were investigated for the purpose of obtaining a new insight into the mechanism of development of the oxide films. It was desirable here to carry out the measurements on optimum defined layers with optimum absence of impurities. This requirement was best satisfied, as found from a comparison of aluminum of different degrees of purity, by Erftal, a 99.9% pure commercial grade. Comparison of different measuring methods and the preparation of specimens of known barrier-layer thickness determined that the latter can be measured through capacitance of the specimens and independently of the possible existence of a cover layer.
Author (TAB)

N66-37226# Frankford Arsenal, Philadelphia, Pa. Pitman-Dunn Research Labs.
INVESTMENT CASTING OF MAGNESIUM–LITHIUM ALLOYS
Anthony Saia and Ralph E. Edelman Jun. 1966 19 p refs
(FA-M66-25-1; AD-635755) CFSTI: HC $1.00/MF $0.50

A method was developed for investment casting magnesium–lithium alloys into inhibited gypsum-bonded molds. Both prototype castings and separately cast-test bars (0.252 inch) were produced. Visual and metallographic examination showed no evidence of metal-mold reaction. Tensile property data were obtained on two previously developed alloys, Mg-14Li-0.5Si and Mg-14Li-5Zn-3Ag-2Si. The strength level and the ductility of the investment-cast test bars were found to correspond with previously measured properties obtained on bars cast into a permanent steel mold (0.505 inch).
Author

N66-37238# Lockheed Missiles and Space Co., Palo Alto, Calif. Research Lab.
DETERMINATION OF TOLERABLE IMPERFECTIONS IN LIGHT METAL SHEET ALLOYS FOR AEROSPACE APPLICATIONS
Richard E. Lewis and Elliott Willner Jun. 1966 35 p refs Presented at the AIAA 4th Aerospace Sci. Meeting (West Coast), Los Angeles, 27–29 Jun. 1966 AIAA Paper-66-524
(LMSC-4-11-66-2; AD-635968) CFSTI: HC $2.00/MF $0.50

Scratches, gouges, pits, and cracks found in high-strength aluminum and magnesium sheet alloy structural components used in highly stressed, light-weight aerospace structures often cause long and expensive delays in making an acceptance or rejection decision. This study was initiated to establish a useful basis for determining the effect of imperfections on gross fracture strength, thus minimizing time delays. The specimens used are 2 in. wide, 8 in. long, and of sheet thickness. A simi-elliptical groove with controlled depth and length is produced in the surface of each specimen at midlength, forming a plane perpendicular to the long dimension. A fatigue crack is generated at the base of the machined groove in each specimen. This fatigue precracked specimen is then tested to failure by uniaxial static tension or tensile fatigue. After failure, the original crack depth and length are measured. Gross and net section stresses and strain energy release rates are then calculated. These results provide quantitative bases for tolerable imperfections. This information can be applied to inspection of as-received sheet material and structural components of aerospace structures.
Author (TAB)

N66-37260# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
COMPOUNDS OF THE RARE-EARTH METALS WITH ALUMINUM AND THEIR CRYSTALLINE STRUCTURES
P. I. Kripyakevich and I. I. Zalutskiy 19 May 1966 7 p refs Transl. into ENGLISH Tr. Inst. Met. Akad. Nauk SSSR (Moscow), 1964 p 144–145
(FTD-HT-66-186; TT-66-61790; AD-635829) CFSTI: HC $1.00/MF $0.50

The data of the investigation and of the existing literature allow certain conclusions to be made about the compositions of compounds of the rare-earth metals with aluminum. While the compounds RAl_2 of the $MgCu_2$ type exist in all systems, the compositions of the compounds richest in aluminum are not identical: Their composition depends upon the atomic radii of the rare-earth metals. As the atomic radius decreases the RAl_4 compounds (R = La, Ce, Pr, Nd) of the $BaAl_4$ type give way to the RAl_3 compounds (R = Sm, Gd, Er) with structures of the Mg_3Cd or $AuCu_3$ types, i.e., superlattices of the densest packing. Europium, whose atomic radius is larger than the radii of the neighboring elements, samarium and gadolinium, forms the compound $EuAl_4$, which is isostructural to compounds of La, Ce, Pr and Nd. With respect to the values of the grid constant the compound $EuAl_4$ is closer to the compound $BaAl_4$ (a = 4.530 A, c = 11.14 A, c/a = 2.460) than to $LaAl_4$ and its analogs (for which c/a = 2.31–2.32), which is connected with the similar atomic radii of Ba and Eu. In the systems of the rare-earth

metals with shorter atomic radii the compounds RAl_3 are close in composition and type of structure to the compounds $HfAl_3$ and $ScAl_3$. TAB

N66-37365*# Arde-Portland, Inc., Paramus, N. J.
FEASIBILITY STUDY OF THE USE OF THERMALLY-INDUCED STRAINING FOR GRAIN REFINEMENT IN RECRYSTALLIZED TUNGSTEN Final Report
[1966] 73 p refs
(Contract NASw-1145)
(NASA-CR-78165) CFSTI: HC $3.00/MF $0.75 CSCL 11F

In order to develop techniques for processing tungsten welds in finished hardware, a feasibility study of grain refinement by thermal straining is presented. Activities involved performing metallurgical studies to set up base line data; heating runs to work out the mechanics of fixturing, heating, and instrumentation; calculations to relate the original predictions of cycles to strain more closely to actual heating conditions; and making runs to determine means of eliminating crack formation in specimens. No conclusion was reached as to the validity of this technique, because of the inability of the plasma gun to operate continuously at the high heat flux necessary to achieve test objectives. S.P.

N66-37387# Naval Radiological Defense Lab., San Francisco, Calif.
ELECTROCHEMICAL CORROSION STUDIES OF SNAP CONTAINER MATERIALS
Dona A. Kubose and Herman I. Cordova 7 Jun. 1966 28 p refs
(USNRDL-TR-1036; AD-635682) CFSTI: HC $2.00/MF $0.50

Corrosion rates of Haynes 25, Hastelloy C and Hastelloy N in natural seawater were determined by galvanostatic polarization techniques. Values of approximately 10^{-2} mils per year were obtained for each of the alloys. No significant effect of aeration and solution stirring on the corrosion rates were observed. Author (TAB)

N66-37397# Institute of Modern Languages, Inc., Washington, D. C.
ON ANODIC OXIDATION OF ALUMINUM IN CHROMIC ACID
F. Modic Ft. Belvoir, Va., Army Engr. Res. and Develop. Labs., [1966] 35 p refs Transl. into ENGLISH from Aluminium (Dusseldorf), v. 39, 1963 p 169-180
(Contract DA-44-009-AMC-1563(T))
(ERDL-T-1854-66; TT-66-61781; AD-635647) CFSTI: HC $2.00/MF $0.50

Particular attention was given to working with bath temperatures above 45°C. Oxide films are here formed much quicker than with the earlier low bath temperatures and are characterized by an attractive and completely opaque appearance. They can also be dyed relatively quickly in saturated tints. They thus become highly suitable for decorative purposes which was not the case in the past. The report also discusses in detail the influence of impurity anions in the chromic acid bath and specifically the effect of sulfate ions on the opaqueness of the anodized items. It further makes suggestions on the control of the bath and/or possibilities of regeneration in the chromic acid process and gives some indications in regard to cost calculation. Author (TAB)

N66-37403# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
METHODS OF TESTING METALS AND ALLOYS FOR CREEP AND VIBRATORY CREEP
L. T. Timoshuk and A. A. Gudkov 26 May 1966 26 p refs Transl. into ENGLISH from Sb. Tr., Tsentr. Nauchn.-Issled. Inst. Chernoi Met. (Moscow), no. 38, 1964 p 123-135
(FTD-HT-66-215; TT-66-61802; AD-635856) CFSTI: HC $1.00/MF $0.50

A stand and measuring apparatus was developed to study creep and vibratory creep in alloys E1726 and E1652. The initial sections of the curves of creep and vibratory creep were investigated for a test time up to 40 hours. The tests were conducted in conditions of a variable temperature and power regime. At test temperatures of 900°C and 1000°C under constant and changed regimes, upon imposition of a vibrational load alloy E1726 exhibited an increased rate of creep at the very start of the test (1-3 hours). After this the rates of creep and vibratory creep remained approximately identical. At any moment of time the absolute expansion under vibratory creep was greater than that under creep. The subposition noted in the literature about the possibility of changing the direction of the effect of vibration upon creep as the test temperature changes was confirmed. The imposition of vibration upon the static part of the load for alloy E1652 at 900 and 1000°C cause opposite effects. In the first case vibration somewhat strengthened the alloy, and in the second case it significantly facilitated deformation. TAB

N66-37407*# Frankford Arsenal, Philadelphia, Pa.
PLANE STRAIN FRACTURE TOUGHNESS OF 2219-T87 ALUMINUM ALLOY AT ROOM AND CRYOGENIC TEMPERATURES
Carl M. Carman, John W. Forney, and Jesse M. Katlin Aug. 1966 43 p refs
(NASA Order C-6860-A)
(NASA-CR-54297; FA-R-1821) CFSTI: HC $2.00/MF $0.50 CSCL 11F

The tensile properties and plane strain fracture toughness of 1/2 and 1 inch thick 2219-T87 aluminum alloy have been determined as a function of testing at temperatures from room to −423°F. The tensile and yield strengths of this material show a gradual increase as the testing temperature is decreased to −423°F while the elongation and reduction of area remain essentially unchanged. The plane strain fracture toughness of this material is relatively insensitive to testing temperature and shows only a slight increase with decreasing testing temperature. Specimens machined so that the crack propagation is perpendicular to the rolling plane show somewhat higher values of plane strain fracture toughness than when crack propagation is parallel to the rolling plane. The plane strain fracture toughness of the 1 inch thick 2219-T87 aluminum alloy was somewhat lower than that of the 1/2 inch thick plate. Illustrative examples are presented using these parameters in design. Author

N66-37460# Carnegie Inst. of Tech., Pittsburgh, Pa.
SOME EFFECTS OF NITROGEN ON THE RESISTANCE TO STRESS CORROSION CRACKING OF TYPE 304 STAINLESS STEEL WIRES
Walter A. Mannheimer and Harold W. Paxton 15 Jun. 1966 16 p refs
(Contract Nonr-760(14))
(AD-635630) CFSTI: HC $1.00/MF $0.50

In recent work on stress corrosion cracking, the role of alloying elements which may effect dislocation distribution and cracking has been discussed. Nitrogen has been introduced into austenitic stainless steels in the solid state from NH_3/H_2 mixtures at temperatures in the range 600-750°C. The resistance to cracking is markedly improved. The reasons for this improvement are under investigation. Author (TAB)

N66-37466# Royal Aircraft Establishment, Farnborough (England).
HYDROGEN PERMEATION MEASUREMENTS ON SOME ELECTRODEPOSITED PROTECTIVE COATINGS FOR HIGH STRENGTH STEELS
H. C. Davis and Josephine A. Gray Jun. 1966 23 p refs
(RAE-TR-66176) CFSTI: HC $1.00/MF $0.50

The apparatus used and the measurements made to determine whether certain standard and special electrodeposited coatings were permeable to hydrogen are described. Cadmium plating showed no measurable permeability at either 30° or 200° C. Coatings produced by the Cleveland cadmium plating process were also found to be impermeable at both temperatures, apparently due to a dense layer formed during the early stages of plating. A zinc-nickel alloy electrocoating containing approximately 18% nickel showed no measurable permeability at 30°C, but a small permeability was obtained at 200°C and this might prove sufficient to allow hydrogen contents to be reduced below embrittling levels.
Author (ESRO)

N66-37572*# Standard Pressed Steel Co., Jenkintown, Pa.
INVESTIGATION OF ADVANCED HIGH STRENGTH ALLOYS USED IN WEIGHT REDUCTION OF THE SATURN V THRUST STRUCTURE. PHASE I: FEASIBILITY STUDY
Edward F. Gowen, Jr. and James J. Glackin 8 Jan. 1966 51 p ref
(Contract NAS8-20158)
(NASA-CR-78303) CFSTI: HC $3.00/MF $0.50 CSCL 11F

This phase was conducted to determine the feasibility of beryllium for high strength blind and semi-blind fasteners. The investigation covered the history of beryllium fasteners and materials, the present state-of-the-art in the production of beryllium fasteners and problem areas that may be encountered in the production of beryllium fasteners. The investigation showed that semi-blind and blind fasteners of beryllium are feasible with ultimate strength on the order of 75,000 psi and shear strengths on the order of 65,000 psi. A planned approach for the development of these fasteners is presented.
Author

N66-37578*# AVCO Corp., Tulsa, Okla. Instrument Div.
A STUDY OF THE BLISTERING OF METAL SURFACES BY SOLAR SYSTEM IONS Final Report, May 1965–May 1966
Leonard H. Milacek and James A. Cooley Aug. 1966 33 p refs Prepared in Cooperation with Okla. Univ. Res. Inst.
(Contract NASw-1203)
(NASA-CR-78313; TR-66-G-106-F) CFSTI: HC $2.00/MF $0.50 CSCL 11F

Samples of pure aluminum, pure gold, and vapor deposited gold on aluminum were irradiated with protons. Tests with pure gold were inconclusive because of rough sample surfaces. Spontaneous blistering and gold removal occurred on the vapor deposited samples during irradiation with 10 and 30 Kev protons. Some oxide removal and blistering during irradiation also occur on pure aluminum samples for protons of less than 100 Kev energy. Pure aluminum irradiated with 100 Kev protons blisters only after annealing at 250°C or higher. The blisters have been shown to occur in the aluminum rather than in the oxide. Pitting occurs in the aluminum oxide during irradiation and the areal pit density has been correlated with crystallographic orientation of the aluminum. Possibility of a similar correlation for the blisters is being studied.
Author

N66-37582# United Kingdom Atomic Energy Authority, Harwell (England). Metallurgy Div.
WETTING AND SPREADING IN REACTIVE SYSTEMS, COPPER-NICKEL
M. Nicholas and D. M. Poole Feb. 1965 32 p refs
(AERE-R-4843)

The secondary spreading kinetics of copper drops on nickel and copper-nickel alloys have been studied. The drop diameters increase linearly with time at rates markedly dependent on the temperature and pre-alloying of the nickel but independent of the mass or alloying of the drop, the wetting atmosphere and the surface roughness of the nickel. A mechanism has been suggested that relates spreading to lateral diffusion of copper in the nickel at the drop edge. The agreement between the predicted and actual activation energies for spreading, 35.5 and 31.8±3.3 Kilo cals/grm mole, is good and the spreading rates of copper on copper-nickel alloys can be accurately predicted from those on pure nickel. The agreement between the predicted and actual pre-exponential terms in the Arrhenius-type spreading rate equation derived from the mechanism, however, is poor and the significance of this is discussed with respect to the validity of the mechanism.
Author

18 MATERIALS, NONMETALLIC

Includes corrosion; physical and mechanical properties of materials (e.g., plastics); and elastomers, hydraulic fluids, etc. For basic research see: 06 Chemistry. For related information see also: 17 Materials, Metallic; 27 Propellants; and 32 Structural Mechanics.

N66-36866# Picatinny Arsenal, Dover, N. J. Plastics and Packaging Lab.
THERMAL DEGRADATION OF TEFLON
Samuel H. T. Lee, Henry Will, III, and David W. Levi Jul. 1966 26 p refs
(PA-TR-3321; AD-635669) CFSTI: HC $1.00/MF $0.50

A differentiator circuit for use with TGA instrumentation was modified and found to be satisfactory with teflon. The studies on teflon indicated that the degradation of this polymer is probably close to first order over the entire temperature range. In addition, no evidence was found for any marked changes in activation energy with conversion in the degradation of this polymer.
Author

N66-36941# AVCO Corp., Wilmington, Mass. Space Systems Div.
SINGLE CRYSTAL ALUMINA BY THE STRAIN–ANNEAL TECHNIQUE Final Technical Report, 25 Mar. 1965–24 Mar. 1966
David J. Sellers, William H. Rhodes, and Thomas Vasilos 24 Mar. 1966 16 p refs
(Contract NOw-65-0316-f)
(AD-635694) CFSTI: HC $1.00/MF $0.50

Single crystals of Al_2O_3 were grown by the strain–anneal technique to a maximum size of 7 cubic centimeters. All the crystals contained a small percentage of porosity, and cracking at the boundary of the polycrystalline region also appeared to be an experimental difficulty. The critical strain for producing few growth nuclei, and thus enhanced single crystal growth, is thought to be approximately 5%. Evidence was obtained for the removal of porosity during grain growth accompanying primary recrystallization.
Author (TAB)

N66-37204# Lexington Labs., Inc., Cambridge, Mass.
DETERMINATION OF THE FEASIBILITY OF FORMING REFACTORY FIBERS BY A CONTINUOUS PROCESS Final Report, 25 Feb. 1963–14 Jun. 1965
William B. Campbell Watertown, Mass., Army Mater. Res. Agency, Jun. 1966 86 p refs
(Contract DA-19-020-AMC-0068(X))
(AMRA-CR-63-03/8F; AD-635587) CFSTI: HC $3.00/MF $0.75

The feasibility of forming whiskers by vapor phase reaction was demonstrated. Whiskers of several materials were grown by oxidation (or reduction) and deposition from the vapor phase, including Al_2O_3, Si_3N_4, SiO_2 and B. Principal effort was directed at producing whiskers Al_3O_3 utilizing the reaction: $2AlCl_3(g)+3CO_2(g)+3H_2(g)$ reversibly yields $Al_2O_3(s)+6HCl(g)+3CO(g)$. Whiskers were grown on stationary substrates and gas-borne nuclei, although limited success was achieved with the latter. Whisker diameter appeared related to the grain size of the substrate or nuclei. High quality whiskers were produced by the process in terms of strength and length to diameter ratio. Measured mechanical properties compared very favorably with reported values obtained from whiskers formed by other processes. A special apparatus was developed for determining mechanical properties. The halide vapor reaction process appears amenable to high production rates because of the potential for continuous production techniques when compared to the batch production processes used presently. Purity and perfection are readily controllable. Author (TAB)

N66-37223*# General Electric Co., Philadelphia, Pa. Missile and Space Div.
STUDY OF THE GROWTH PARAMETERS INVOLVED IN SYNTHESIZING BORON CARBIDE FILAMENTS Second Quarterly Report
A. Gatti, E' Feingold, J. J. Gebhardt, and V. A. Cordua 20 Aug. 1966 20 p refs *Its* Rept.-214-1 B6
(Contract NASw-1383)
(NASA-CR-78260) CFSTI: HC $1.00/MF $0.50 CSCL 11D

The growth of B_4C whiskers, characterization of B_4C whiskers in terms of mechanical properties and crystalline perfection, and incorporation of B_4C whiskers in composite specimens have been investigated. A renewed effort has been made to grow B_4C whiskers by the dynamic method, and studies were continued on the effects of growth and deposition zone geometry of the chimney type furnace on whisker production. Annealing research has indicated that extensive weakening of B_4C whiskers occurs when the whiskers are heated for one hour above 1600°C, however, annealed whiskers have straightened after heat treatment above 1500°C. It is also reported that in whisker growth using the pure vapor method, geometric conditions existing within the growth area restrict the perfection and ultimate length of whiskers which can be grown. A.G.O.

N66-37379# Ballistic Research Labs., Aberdeen Proving Ground, Md.
APPLICATION OF FAST NEUTRON ACTIVATION ANALYSIS TO POLYMER DOSIMETRY
Arthur D. Coates and Voe A. Swisher Mar. 1966 22 p refs
(BRL-R-1312; AD-635655) CFSTI: HC $1.00/MF $0.50

Fast neutron activation analysis was used to measure the gamma dose absorbed by a polymer. A series of low density polyethylene films was irradiated by cobalt-60 gamma rays in the presence of air. The oxygen content of the polymer films increased with increasing dose. The increase in oxygen content of each film was monitored at 1720 cm^{-1} by infrared spectroscopy. The oxygen increase also was monitored by measuring the activation of oxygen-16. This latter method employs fast neutron activation of oxygen-16 and the measurement of the emitted radiation to determine gamma dose. The results of both methods of dosimetry are presented, and the improvements offered by the neutron activation technique are indicated. Author (TAB)

N66-37417*# National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.
ABLATIVE AND INSULATING PROPERTIES OF OUTGASSED BORON NITRIDE AND BORON NITRIDE COMPOSITE
Arthur F. Okuno Washington, NASA, Oct. 1966 21 p refs
(NASA-TN-D-3660) CFSTI: HC $1.00/MF $0.50 CSCL 11B

Hot-pressed boron nitride that had been outgassed in vacuum ablated with negligible spalling when exposed to a jet of arc-heated air. The measured heats of ablation ranged from 30 to 35 MJ/kg for an enthalpy potential range of 16 to 23 MJ/kg. No ablation occurred in nitrogen at enthalpies up to 26 MJ/kg. A composite of boron nitride and phenolic resin was evaluated in both arc-heated air and nitrogen at enthalpy potentials from 8 to 15 MJ/kg and from 15 to 21 MJ/kg, respectively. Poor high-temperature bonding characteristics reduced the heats of ablation to approximately half those of hot-pressed boron nitride. The insulation efficiencies of the composite, pyrolytic boron nitride, boron nitride, and phenolic nylon, were studied at cold-wall convective heating rates of 1.4 to 2 MJ/m^2-sec in arc-heated air and 1.9 to 2.5 MJ/m^2-sec in arc-heated nitrogen. When compared on the basis of the total cold-wall heat input per initial pound of material for a back-face temperature rise of 167°K, the composite was twice as effective as either pyrolytic boron nitride or hot-pressed boron nitride. Author

N66-37445# Polytechnic Inst. of Brooklyn, N. Y.
EXTENSIONAL MECHANICAL PROPERTIES OF POLYESTER AND POLYETHER BASED POLYURETHANES
Jerome M. Klosner, Alexander Segal, and Howard N. Franklin Jun. 1966 50 p refs
(Contract Nonr-839(32) FBM; Grant NSF GP-1246)
(PIBAL-922; AD-635788) CFSTI: HC $2.00/MF $0.50

An investigation of the extensional mechanical properties of a polyester based polyurethane and a polyether based polyurethane is described. Dynamic steady-state tests were performed over a frequency range of 1000 to 8000 cps and a temperature range of 50° to 110°F for the polyester material held at a constant elongation of 105%. The experiments on the polyether were conducted at 110% initial elongation over a range of frequency of 200 to 1600 cps, and a temperature range of 50° to 110°F. The complex modulus is found for both materials and the reduced variable concept applied. Master curves for the moduli are determined for a reference temperature of 510°R (50°F). Relaxation tests were performed on the same materials and the relaxation modulus determined. The relaxation spectrum is determined by using the data from the dynamic and relaxation experiments. Author (TAB)

N66-37681*# General Electric Co., Philadelphia, Pa. Missile and Space Div.
ENHANCEMENT OF THE TRANSVERSE PROPERTIES OF FIBROUS COMPOSITES Final Report
Norris F. Dow Feb. 1966 46 p refs Presented at the 21st Ann. Meeting of the Reinforced Plastics Div., Soc. of the Plastics Ind., Chicago, 8–10 Feb. 1966
(Contract NASw-1144)
(NASA-CR-78307; R66SD38) CFSTI: HC $2.00/MF $0.50 CSCL 11I

A method of analysis is developed for the determination of the elastic constants of a variety of configurations of three-

dimensional filamentary reinforcement for plastics. This analysis is employed in preliminary evaluations of the effectiveness of several approaches to the enhancement of properties transverse to the filaments. For glass-reinforced epoxies, binders of increased stiffness, elliptical filaments, and triangular filaments are all shown capable of effecting improvements in transverse stiffnesses. For epoxies reinforced by advanced filaments like boron, however, nearly this degree of improvement was found possible through proper filament orientation. Further studies of other configurations and combinations are suggested. Author

19 MATHEMATICS

Includes calculation methods and theory; and numerical analysis. For applications see: 08 Computers.

N66-36529 Fairchild Hiller Corp., Bladensburg, Md. Electronics and Information Systems Div.

SYSTEM RELIABILITY MATHEMATICAL MODELING

Lee R. Webster *In* Canaveral Council of Tech. Soc. 3d Space Congr. 1966 p 309–323 refs (See N66-36506 22-30)

This paper discusses the general procedures and considerations involved in the construction and improvement of system reliability models. Specific points covered include the performance of supporting operations analyses; the utilization of the system block diagrams and the failure mode and effect analysis in generating the system reliability diagram; and a summary of many of the more widely used mathematical tools used to transform the system function diagram into a system reliability expression. The application of the procedure discussed is demonstrated on the power control and conversion assemblies of the Advanced Orbiting Solar Observatory (AOSO). Author

N66-36532# University of Southern Calif., Los Angeles.

RELIABILITY AND CONFIDENCE OF SERIALLY CONNECTED SYSTEMS

George J. Schick and Richard J. Prior (Douglas Aircraft Co., Inc., Santa Monica, Calif.) *In* Canaveral Council of Tech. Soc. 3d Space Congr. 1966 p 352–360 refs (See N66-36506 22-30)

A discussion is presented on the question of how component reliabilities at different or identical confidence levels can be combined to find the system reliability at a chosen confidence level. Examples are cited to illustrate the various techniques outlined to deal with this problem. Serially connected systems are considered, and it is assumed that failures are statistically independent. Various formulae are presented for approximate, exact, and asymptotic solutions of the equation. A Bayesian approach is discussed in which the problem of serial confidence limits reduces to one of finding the density function of the product of two or more variables, and the a priori density functions of these variables are assumed to be known. It is concluded that many approximate solutions lack rigorous mathematical derivations, and their worth must be measured in comparison with each other and with exact solutions. S.P.

N66-36812# Grenoble Univ. (France).

ANNALS OF THE FOURIER INSTITUTE, 1966, VOLUME XVI, PART I [ANNALES DE L'INSTITUT FOURIER, 1966, TOME XVI, FASCICULE I]

1966 399 p refs In FRENCH and ENGLISH CFSTI: HC $7.00/MF $2.00

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9. EXTENSION OF COHERENT ANALYTIC SETS J.-P. Serre (Coll. de France) p 363–374 refs (See N66-36821 22-19)

N66-36813# Institut d'Etudes Scientifiques de Nice (France).

THE PROBLEM OF MODULES FOR COMPACT ANALYTIC SPACES OF A GIVEN ANALYTIC SPACE [LE PROBLEME DES MODULES POUR LESS SOUS-ESPACES ANALYTIQUES COMPACTS D'UN ESPACE ANALYTIQUE DONNE]

Adrian Douady *In* Grenoble Univ. Ann. of the Fourier Inst. 1966 p 1–95 refs In FRENCH (See N66-36812 22-19) CFSTI: HC $7.00/MF $2.00

The basis of a theory of analytic Banach spaces is formulated to study the problem of modules for compact analytic subspaces. If X is a separated complex analytic space, the set H(X) of compact analytic subspaces of X can be provided with an analytic space structure. In broader terms, this includes cases where ϵ is a coherent analytic sheaf on X, and the set H(ϵ) of quotient sheaves of ϵ, are coherent and on a compact support. Also discussed are the theorem of privileged neighborhoods, morphism, the theorem of existence, and the application of space morphisms. Transl. by R.L.

N66-36814# College Scientifique Universitaire de Perpignan (France).

STUDY OF SOME PROBLEMS REGARDING FUNCTIONS THAT CAN BE APPROXIMATED BY SUMS OF EXPONENTIALS, AND THE FOURIER-CARLEMAN TRANSFORM OF AN APPROXIMATELY PERIOD FUNCTION [ETUDE DE QUELQUES PROBLEMES RELATIFS AUX FUNCTIONS APPROCHABLES PAR DES SOMMES D'EXPONENTIELLES ET A LA TRANSFORMEE DE FOURIER-CARLEMAN D'UNE FONCTION PRESQUE PERIODIQUE]

Aimée Baillette *In* Grenoble Univ. Ann. of the Fourier Inst. 1966 p 97–120 refs In FRENCH (See N66-36812 22-19) CFSTI: HC $7.00/MF $2.00

Consideration is given to sets λ of distinct non-null, real numbers which are the spectrum of an indefinitely derivable, approximately periodic function, of which all derivations are nearly periodic and which, for the Fourier-Carleman transform, has the inverse of a canonical product which is canceled by set λ. Applications are presented to a weighted approximation problem, and to a problem of continuity of a function of two real variables. Mathematical representations of theorems postulated are included. Transl. by R.Ll.

N66-36815 Cambridge Univ. (England).
A DIRECT DECOMPOSITION OF THE MEASURE ALGEBRA OF A LOCALLY COMPACT ABELIAN GROUP
N. Th. Varopoulos *In* Grenoble Univ. Ann. of the Fourier Inst. 1966 p 121–143 refs (See N66-36812 22-19) CFSTI: HC $7.00/MF $2.00

Measures are obtained for which the Fourier transform is canceled, and a direct decomposition of M(G) of a locally compact Abelian group is discussed. Of the applications advanced on this decomposition, it is shown that $M_c \neq \overline{M_c^2}$ and $\overline{M_0^2} \neq M_0$. Algebraic and geometric results on independent sets are also presented. Transl. by R.Ll.

N66-36816# Nagoya Univ. (Japan). Mathematical Inst.
ON THETA BOUNDED HARMONIC FUNCTIONS
Mitsuru Nakai *In* Grenoble Univ. Ann. of the Fourier Inst. 1966 p 145–157 refs (See N66-36812 22-19) CFSTI: HC $7.00/MF $2.00

A non-negative, real-valued function Φ (t) defined on the half real line $(0,\infty) = (t; 0 \leq t < \infty)$ is discussed, along with a harmonic function u on a Riemann surface R, which is called Φ-bounded if the composite function Φ (|u|) admits a harmonic majorant on R. Studied is class H Φ (R) of phi-bounded functions on R; proof to a theorem is presented which shows that every u of H Φ (R) is essentially positive for every R, if and only if $\inf t \to \infty$ Φ (r)/t > 0. Transl. by R.Ll.

N66-36817# Paris Univ. (France). Faculte des Sciences.
PARTIALLY RECURRENT SETS (APPLICATIONS TO MODULE DISTRIBUTION AND TO ARITHMETIC PROPERTIES OF ANALYTIC FUNCTIONS) [SUITES PARTIELLEMENT RECURRENTES (APPLICATIONS A LA REPARTITION MODULO I ET AUX PROPRIETES ARITHMETIQUE DES FONCTIONS ANALYTIQUES]
Gérard Rauzy In Grenoble Univ. Ann. of the Fourier Inst. 1966 p 159–234 refs In FRENCH (See N66-36812 22-19) CFSTI: HC $7.00/MF $2.00

In a study of partially recurring sets, to every set of positive integrals, a number ≥1 is attached, which is ultimately infinite; and which is called the frequency of this set; the number measures the relative length of consecutive integrals of this set. The notion of frequency shows slight relation to the notion of density, and a set and its complementary may both be of infinite frequency. One result obtained gives a common characteristic of the Pisot and Salem numbers. Its reciprocal shows that set J can be constructed so that the set of λ correspondents has the power of a continuum. If θ is a Salem number, an almost direct application of the Roth theorem shows that the λ correspondents are transcendents. Transl. by R.Ll.

N66-36818# Illinois Univ., Urbana. Dept. of Mathematics.
THE SPACE OF BOUNDED ANALYTIC FUNCTIONS ON A REGION
L. A. Rubel and A. L. Shields (Mich. Univ.) *In* Grenoble Univ. Ann. of the Fourier Inst. 1966 p 235–277 refs Prepared in cooperation with Mich. Univ. (See N66-36812 22-19) CFSTI: HC $7.00/MF $2.00
(Grant AF-AFOSR-460-63)

Bounded analytic functions are studied by two types of topologies. Both strong and weak-star topologies are investigated. Definitions, explanation of symbols used, and a bibliography are presented. Closed ideals in β (G) are discussed in some detail. A mathematical technique reported is a type of balayage. Transl. by R. Ll.

N66-36819# Lund Univ. (Sweden). Inst. of Mathematics.
INTERPOLATION SPACES AND SOBOLEFF THEOREM [ESPACES D'INTERPOLATION ET THEOREME DE SOBOLEFF]
Jaak Peetre *In* Grenoble Univ. Ann. of the Fourier Inst. 1966 p 279–317 refs In FRENCH (See N66-36812 22-19) CFSTI: HC $7.00/MF $2.00

Fourier analysis, Hilbert transforms, interpolation spaces, and the Soboleff theorem are some of the mathematical topics discussed in this report series. The classic theorem of the Hilbert transform in R^1 in application to the Lipschitz function space is reviewed. By the same technique, the generalization of the Hilbert transform in R^n as well as the potential transform are presented. Other classic results of Hardy, Littlewood, Soboleff, and Thorin are reported. Also included are the proof and variation of Soboleff's theorem, and an application of Stampacchia's interpolation theorem.
Transl. R. Ll.

N66-36820# Moscow State Univ. (USSR). Faculty of Mechanics and Mathematics.
ON THE DIFFERENTIAL GEOMETRY OF THE LIE GROUPS OF INFINITE DIMENSION AND THEIR APPLICATIONS TO THE HYDRODYNAMICS OF PERFECT FLUIDS [SUR LA GEOMETRIE DIFFERENTIELLE DES GROUPS DE LIE DE DIMENSION INFINIE ET SES APPLICATIONS A L'HYDRODYNAMIQUE DES FLUIDES PARFAITS]
V. Arnold *In* Grenoble Univ. Ann. of the Fourier Inst. 1966 p 319–361 refs In FRENCH (See N66-36812 22-19) CFSTI: HC $7.00/MF $2.00

Euler's theorems on the geodesics of group SO(3), with a metric left invariant, are extended to an arbitrary Lie group (group SDiffD of diffeomorphisms D), by preserving the volume. The SDiffD geodesics for perfect fluids, and the criterion of nonlinear hydrodynamic stability are discussed. The Riemann curvature of SDiffD is calculated and found to be negative in all sections. Transl. by R.Ll.

N66-36821# Collège de France, Paris.
EXTENSION OF COHERENT, ANALYTIC SETS [PROLONGEMENT DE FAISCEAUX ANALYTIQUE COHERENTS]
Jean-Pierre Serre *In* Grenoble Univ. An. of the Fourier Inst. 1966 p 363–374 refs In FRENCH (See N66-36812 22-19) CFSTI: HC $7.00/MF $2.00

A continuum criterion (enabling the existence of an automorphic form of sheaf G to be affirmed) is advanced. Let X be a normal complex analytic space, and let S be a closed, analytic subset of X, having codimension ≥2, and let F be a torsion-free, coherent, analytic sheaf on X—S. The equivalence of the following three properties is demonstrated: (1) The direct image of F by injection X—S→X is a coherent sheaf on X. (2) There is a coherent analytic sheaf on X which is a continuum of F. (3) For every $x \in S$, there is an open

neighborhood U of s so that the restriction of F to U—S$\cap$U is engendered by sections U—S$\cap$U. It is stated that the implications (i)→(ii)→(iii) are trivial. The implication (iii)→(i) utilizes the Remmert-Stein theorem on the continuum of submanifolds. It is shown that when X is a projective manifold, existing conditions (i), (ii), and (iii) mean that sheaf F is algebraic.
Transl. by R.LI.

N66-36846*# International Business Machines Corp., Gaithersburg, Md.
A GENERAL METHOD FOR THE COMPUTATION OF CARTESIAN COORDINATES AND PARTIAL DERIVATIVES OF THE TWO-BODY PROBLEM
W. H. Goodyear Washington, NASA, Sep. 1966 103 p refs
(Contract NAS5-9762)
(NASA-CR-522) CFSTI: HC $3.00/MF $0.75 CSCL 12A

A double-precision Fortran 4 subroutine for the IBM 7094 is developed for the solution of cartesian coordinates and partial derivatives for all possible cases of the two-body problem. The derivation of all the equations used in the subroutine is presented, along with detail descriptions of the computations. The solution for the coordinates is derived by defining a new independent variable with a differential equation that was previously used by Sundman for a three-body problem; and the solution is a modification of that originally given by Stumpff. It is shown that the new variable is a generalization of the eccentricity anomaly, and that the relationship of the general solution of coordiantes to the classical formulas for elliptic two-body motion is a generalization of Kepler's equation. Partial derivatives are obtained by differentiating the solution for coordinates and manipulating the results algebraically. A detailed description of the subroutine is included. M.W.R.

N66-36892# Applied Physics Lab., Johns Hopkins Univ., Silver Spring, Md.
ON THE APPROXIMATE SOLUTION OF THE DIRICHLET PROBLEM FOR POISSON'S EQUATION USING A-PRIORI POINTWISE BOUNDS AND CONTINUOUS APPROXIMATING FUNCTIONS
David G. Grant (M.A. Thesis—Md. Univ.) May 1966 100 p refs
(Contract NOw-62-0604-c)
(TG-828; AD-635965) CFSTI: HC $3.00/MF $0.75

Pointwise bounds on the solution of the Dirichlet problem for Poisson's equations are developed. The bounds are apriori in nature and thus are completely determined by the Dirichlet data and the geometry of the region. To obtain a solution at a point one first formally substitutes the difference between the solution function and an unspecified continuous approximating function into the original bound expression. The resultant expression represents a bound on the error between the two functions at the point. This error bound is then minimized by proper choice of the approximating function as determined by the Rayleigh-Ritz procedure. In the limit the value of the approximating function equals the value of the solution at the point in question. Error bounds, calculated by the method of Rayleigh-Ritz, as well as actual errors are determined for a number of specified test problems. In this paper this approach is evaluated on the basis of both the effort required to obtain results and the quality of the results themselves in order to ascertain its value as a general method of solution. Author (TAB)

N66-36912# Philco Corp., Blue Bell, Pa. Communications and Electronics Div.
ADAPTIVE MODELLING OF LIKELIHOOD CLASSIFICATION—I Final Report, 13 Jan. 1965–13 Jan. 1966
Laveen N. Kanal and Kenneth Abend Griffiss AFB, N. Y., RADC, Jun. 1966 185 p refs
(Contract AF 30(602)-3623)
(B008; RADC-TR-66-190; AD-636519) CFSTI: HC $3.00/MF $1.00

The purpose of this study is the development and evaluation of adaptive networks to represent broad classes of likelihood functions. Orthogonal expansions for multivariate distributions of discrete and continuous random variables are investigated for this application. To overcome the problem of high dimensionality, Markovian processing of discrete spatial patterns is introduced. In addition, adaptive threshold adjustment procedures and an optimal method for taking context into account are derived from compound decision theory. Experimental results, on the classification of visual patterns by a two layer, two threshold network, are also presented. Author (TAB)

N66-36951# Oak Ridge National Lab., Tenn. General Engineering and Construction Div.
NUMERICAL ANALYSIS OF A PARABOLIC PARTIAL DIFFERENTIAL EQUATION CONTAINING BOTH FLOW AND DIFFUSION TERMS
T. W. Pickel (M.A. Thesis—Tennessee Univ.) Jun. 1966 116 p refs
(Contract W-7405-ENG-26)
(ORNL-TM-1497) CFSTI: HC $4.00/MF $0.75

Two approaches for the numerical solution of a partial differential equation containing both flow and diffusion terms were investigated. In the first approach, explicit difference equations were used to approximate the differential equation. In the second approach, the diffusion and flow effects were calculated separately and then combined to obtain a solution. The stability and convergence requirements for each approach were determined. Numerical examples were calculated on a Control Data Corporation Model 1604 computer to test these approaches, two methods being tested for each approach. The numerical examples indicate that the approach of separating the effects of flow and diffusion gives a better approximation to the partial differential equation. Possible changes in the calculation procedure for this approach that would improve the accuracy for a given computer running time are indicated. Author (NSA)

N66-36968# General Electric Co., Schenectady, N.Y. Knolls Atomic Power Lab.
LIZARD-IV: A PROGRAM TO SOLVE NONLINEAR, ORDINARY DIFFERENTIAL EQUATIONS
Robert W. Guillette, Gerhard O. Mueller, and Joseph R. Schmid 17 Mar. 1966 25 p refs
(Contract W-31-109-ENG-52)
(KAPL-M-6548) CFSTI: HC $1.00/MF $0.50

LIZARD-IV is a program that can be used to solve nonlinear, ordinary differential equations. The program is capable of handling up to twenty-five first order equations. Higher order equations must be reduced to first order by the substitution of new dependent variables. Several examples, typical of problems that can be solved with this program, are illustrated. The results may also be plotted using the CALCOMP Plotter. Typical running time for a LIZARD-IV problem is dependent upon the number of equations, number of terms per equation, and the number of time steps required for the solution. Several two-equation LIZARD-IV runs, using 200 time steps, consumed between 55 and 70 seconds of machine time on a Philco 2000-212 computer. The LIZARD-IV program supersedes LIZARD, the original FORTRAN-II version of the program. The LIZARD-IV program is written in FORTRAN-IV language. Author (NSA)

N66-37061# Purdue Univ., Lafayette, Ind. Dept. of Statistics.
WAITINGTIMES BETWEEN RECORD OBSERVATIONS
Marcel F. Neuts Jul. 1966 8 p refs
(Contract Nonr-1100(26))
(AD-635674) CFSTI: HC $1.00/MF $0.50

If delta sub r denotes the waitingtime between the (r-1)st and the rth upper record in a sequence of independent, identically distributed random variables with a continuous distribution, then it is shown that delta sub r satisfies the weak law of large numbers and a central limit theorem. These theorems supplement those of Foster and Stuart and Renyi, who investigated the index V sub r of the rth upper-record. Qualitatively the theorems establish the intuitive fact that for higher records, the waiting-time between the last two records outweighs even the total waitingtime for previous records. This explains also why the asymptotic normality of log V sub r is very inadequate for approximation purposes—Barton and Mallows. Author (TAB)

N66-37064# Carnegie Inst. of Tech., Pittsburgh, Pa. Management Sciences Research Group.
SEMI-INFINITE PROGRAMMING, DIFFERENTIABILITY AND GEOMETRIC PROGRAMMING, PART II
Abraham Charnes (Northwestern Univ.), William W. Copper, and Kenneth O. Kortanek (Cornell Univ.) Apr. 1966 15 p refs *Its* Management Sci. Res. Rept.-74
(Contract Nonr-1228(10))
(AD-635900) CFSTI: HC $1.00/MF $0.50

The CCK duality theory of semi-infinite programming is specialized to situations involving differentiability (or partial differentiability) of objective and constraint functions to obtain in a uniform and direct manner various results and interpretations, such as generalization of the Kuhn-Tucker Theorem, the 'geometric' programming of Duffin-Peterson, and the Slater constraint qualification example. Author (TAB)

N66-37073# Boeing Scientific Research Labs., Seattle, Wash. Mathematics Research Lab.
SUFFICIENT CONDITIONS CONNECTED WITH DIFFERENTIAL INEQUALITIES OF THE FOURTH ORDER
Johann Schroder Feb. 1966 37 p refs *Its* Mathematical Note No. 454
(DI-82-0510; AD-635961) CFSTI: HC $2.00/MF $0.50

A fourth order differential equation, $L[u](x)=r(x)$ $(0\leq x\leq 1)$, with analytic coefficients is considered together with linear homogeneous boundary conditions $U_i[u]=0$ $(i=1,2)$ at $x=0$ and $V_i[u]=0$ $(i=1,2)$ at $x=1$. If L_1 and L_2 denote differential operators of the second order, and if $L_2[L_1[u]]=w(x)L[u]+Q(x)u$, this equation exhibits a splitting of the operator L. Let R denote the set of functions u(x) which are analytic on [0,1] and satisfy the given boundary conditions. In a previous paper it was proved that, under suitable assumptions, $L[u](x)\geq 0$ $(0\leq x\leq 1)$ implies $u(x)\geq 0$ $(0\leq x\leq 1)$ and $L[u](x)\geq 0$ $(0\leq x\leq 1)$ for all u and R. These assumptions require certain properties of the splitting, but they do not show how to choose such a splitting. In this paper, the assumptions are investigated further and they are transformed in certain ways. In particular, the construction of a suitable splitting is reduced to the solution of a system of linear equations and inequalities. A series of examples of specific problems and their solutions by these techniques are included. C.T.C.

N66-37169# Utah Univ., Salt Lake City. Dept. of Mathematics.
LIAPUNOV STABILITY FOR NONLINEAR DIFFERENTIAL EQUATIONS
Arlet Iris Boyer (M.S. Thesis) Jun. 1966 38 p refs
(Contract AF 33(608)-1288)
(AD-635238) CFSTI: HC $2.00/MF $0.50

This thesis treats stability of non linear differential equations of type (1) $y'=f(y)$ and (2) $y'=f(t,y)$ where y and f are vectors. The two methods used are linear approximation and Liapunov's Second Method. The method of linear approximation requires that we find a linear matrix A, constant or periodic, such that

$$\frac{||f(y)-A(t)y||}{||y||}$$

goes to zero as $||y||$ goes to zero. If this condition exists then the linear portion will control the stability of the system. Liapunov's Second Method uses a testing function to determine whether the system is stable. One advantage of this method is that it is not necessary to know any solution in order to formulate a testing function. Author

N66-37174# Purdue Univ., Lafayette, Ind. Dept. of Statistics.
ON MAXIMUM VALUES IN CERTAIN APPLIED STOCHASTIC PROCESSES
Marcel F. Neuts Jun. 1966 15 p refs
(Contract Nonr-1100(26))
(AD-635690) CFSTI: HC $1.00/MF $0.50

We consider the problem of finding the maximum observation in [o,t] for a class of processes having an imbedded semi-Markov process. In a particular subclass which includes the GI|M|1 queue and some type II counters, we get more explicit results. Author

N66-37179# George Washington Univ., Washington, D. C. Dept. of Statistics.
TOPICS IN INFORMATION AND DECISION PROCESSES Technical Report, Sep. 1964–May 1965
Minoru Sakaguchi Jul. 1966 161 p refs
(Grant Nonr(G)-00029-65)
(AD-635941) CFSTI: HC $5.00/MF $1.00

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N66-37195# Boeing Scientific Research Labs., Seattle, Wash.
MEAN-SQUARE APPROXIMATION BY GENERALIZED RATIONAL FUNCTIONS
E. W. Cheney (Texas Univ.) and A. A. Goldstein (Washington Univ.) Jun. 1966 19 p refs Sponsored by AFOSR and Army Res. Office *Its* Mathematical Note No. 465
(DI-82-0538; AD-636041) CFSTI: HC $1.00/MF $0.50

The problem of numerical analysis to which this study is directed is that of determining an optimum approximation (in the least squares sense) to a given function f by a function of the form p/q, where p and q are confined to certain pre-

scribed linear spaces. The analogous approximation problem employing the uniform norm has received much recent attention. To our knowledge no investigation of the present problem has appeared. Author (TAB)

N66-37212*# RAND Corp., Santa Monica, Calif.
STATISTICAL ESTIMATION PROCEDURES FOR THE "BURN-IN" PROCESS
Richard E. Barlow, Frank Proschan, Ernest M. Scheuer, and Albert Madansky Sep. 1966 21 p refs
(Contract NASr-21)
(NASA-CR-78131; RM-5109-NASA) CFSTI: HC $1.00/MF $0.50 CSCL 12A

In this process, items whose failure rate is assumed to decrease with time are put on test (burnt-in) until a fixed amount of time has elapsed (truncated sampling) or until a fixed number of failures have occurred (censored sampling). The purpose is to identify and eliminate poor-quality or defective items. For both of the modes of observation described, we provide a conservative upper confidence bound for the failure rate at the time the burn-in process ends, and the maximum likelihood estimate (MLE) of the failure-rate function. These results are valid under quite general conditions. In particular, we do not require that the form of the life distribution be known. The MLE is obtained under the sole assumption that the failure-rate function is decreasing. The confidence bound is obtained under the even weaker assumption that the failure rate at the time observation ends is no larger than the failure rate throughout the period of observation.
Author

N66-37257# Applied Physics Lab., Johns Hopkins Univ., Silver Spring, Md.
A METHOD OF SOLVING A BOUNDARY-VALUE PROBLEM FOR A LINEAR SECOND-ORDER DIFFERENTIAL EQUATION
I. F. Gredzhuk 17 Jun. 1966 14 p refs Transl. into ENGLISH from Ukr. Mat. Zh. (Kiev), v. 16, no. 3, 1964 p 375–382
(Contract NOw-62-0604-c)
(TG-230-T482; TT-66-61811; AD-635892) CFSTI: HC $1.00/MF $0.50

A method is considered for finding upper and lower approximations for the solution y(x) of a boundary-value problem $y'' - q(x)y = 0$ for a linear second-order differential equation. The approximations are sought in the form of an n-th degree polynomial. As the degree of the polynomial increases, the error is sharply decreased. Author (TAB)

N66-37258# Aeronautical Chart and Information Center, St. Louis, Mo. Linguistic Section.
COMPLETE RADIAL VARIATION OF ONE CLASS OF HARMONIC FUNCTIONS [O POLNOY RADIAL'NOY VARIATSII ODNOGO KLASSA GARMONICHESKIKH FUNKTSIY]
V. S. Zakharyan and E. O. Nazaryan Jun. 1966 13 p refs Transl. into ENGLISH from Dokl. Akad. Nauk Arm. SSR, v. 41, no. 2, 1965 p 65–72
(ACIC-TC-1073; TT-66-61777; AD-635574) CFSTI: HC $6.00/MF $0.50

Translation of Russian research: complete radial variation of one class of harmonic functions. TAB

N66-37263# Boeing Scientific Research Labs., Seattle, Wash. Mathematics Research Lab.
CONTINUITY OF SOME CONVEX-CONE-VALUED MAPPINGS
David W. Walkup and Roger J. B. Wets Jun. 1966 14 p refs /ts Mathematical Note No. 471
(DI-82-0543; AD-635960) CFSTI: HC $1.00/MF $0.50

The authors consider the class C of closed convex cones in a Hilbert space as a topological space and investigate the resulting topological properties of certain mappings into C. They show that with the proper choice of a Hausdorff metric for C the operation of taking the polar cone is an involutory isometry. The operation is considered of taking the positive hull of a finite set of points as a mapping into C and obtain some sufficient conditions for the continuity of this mapping. Author (TAB)

N66-37339# Atomics International, Canoga Park, Calif.
SPENCER: A FORTRAN PROGRAM TO APPROXIMATELY RECONSTITUTE A ONE-DIMENSIONAL FUNCTION FROM A FINITE NUMBER OF ITS MOMENTS
Bruce D. O'Reilly and Richard C. Lewis Nov. 1965 35 p refs
(Contract AT(11-1)-GEN-8)
(NAA-SR-MEMO-11653) CFSTI: HC $2.00/MF $0.50

The approximate reconstitution of a function G(x), from a finite number of its moments is accomplished using L. V. Spencer's function-fitting method. G(x) is assumed to exist in the region $-\infty < x < \infty$. The even and odd components of G(x) are assumed to be fitted by the forms.

$$G_e(x) = {}^1/_2[G(x)+G(-x)] \doteq G_e(x) = \sum_{j=11}^{J} \frac{a_{ej}}{\sqrt{b_{ej}}} f \frac{x}{\sqrt{b_{ej}}}$$

and

$$G_0(x) = {}^1/_2[G(x)-G(-x)] \doteq G_0(x) = \sum_{j=11}^{J} \frac{a_{0j}}{b_{0j}} f \frac{x}{\sqrt{b_{0j}}}$$

The method extends directly to the reconstitution of functions existing only in the semi-infinite domain $0 \leq x < \infty$. The form of the trial function f is chosen to reflect whatever characteristics of G(x) are known a priori. The use of the FORTRAN II code SPENCER, which implements the application of Spencer's method, is discussed. The preparation of input data for a sample problem are given in an appendix. Some emphasis is placed on showing how the code can be used to numerically invert certain types of integral transforms. Author (NSA)

N66-37380# RAND Corp., Santa Monica, Calif.
AN EXTENSION OF PALM'S THEOREM FOR (M/G/s) QUEUES TO THE CASE WHERE SERVICE RATES ARE DEPENDENT ON THE NUMBER OF BUSY CHANNELS
Craig C. Sherbrooke Jul. 1966 10 p refs
(P-3406; AD-635688) CFSTI: HC $1.00/MF $0.50

An S channel queueing facility is considered where arrivals are Poisson. When all S channels are busy subsequent arrivals are lost. There is one arbitrary service distribution applicable to all channels, but the service rate is dependent on the number of busy channels. It is shown that the steady state probabilities are those which would be obtained under the assumption of exponential service. The model is related to an inventory problem with expediting. Author (TAB)

N66-37404# Naval Ordnance Lab., White Oak, Md.
A FINITE DIFFERENCE METHOD FOR GENERALIZED RADIAL TRANSPORT EQUATIONS
Avron Douglis 21 Jun. 1966 53 p refs
(NOLTR-66-130; M-64; AD-635591) CFSTI: HC $3.00/MF $0.50

A mode of calculation is justified for the solutions of generalized radial transport equations with initial and boundary conditions appropriate to a bare reactor. Author (TAB)

N66-37413*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
A MILLISECOND CONVERSION TABLE
Donald E. Jamison Sep. 1966 17 p
(NASA-TM-X-55563; X-564-66-426) CFSTI: HC $1.00/MF $0.50 CSCL 12A

Tables are presented which convert seconds, hours, and days to milliseconds. The tables were generated to aid in performing data analyses involving time presented in units of the Gregorian calendar and mean Greenwich time. Major applications are for the determination of time periods to establish data transitions and for time differential checks to verify synchronized and continuous data patterns. C.T.C.

N66-37416*# National Aeronautics and Space Administration. Electronics Research Center, Cambridge, Mass.
DIFFERENTIAL GAMES AND MANUAL CONTROL
Sheldon Baron Washington, NASA, Oct. 1966 18 p refs
(NASA-TN-D-3659) CFSTI: HC $1.00/MF $0.50 CSCL 12A

Variational methods are used to solve a particular pursuit-evasion differential game. The problem involves the determination of optimal strategies for both the pursuer and evader. The performance measure is the miss distance at some fixed terminal time. Both pursuer and evader have limited control energy. The performance of a trained research pilot, for both single- and two-axis control tasks, is compared with that of the optimal pursuer. State vector display and quickened display are discussed. The results suggest that differential game problems could be quite useful in the study of manual control. Author

N66-37434# RAND Corp., Santa Monica, Calif.
AN APPROXIMATE PSEUDOINVERSE SOLUTION TO ILL-CONDITIONED LINEAR SYSTEMS
Allen Klinger Jul. 1966 17 p refs
(Contract AF 49(638)-1700; Proj. RAND)
(RM-4981-PR; AD-635935) CFSTI: HC $1.00/MF $0.50

The matrix pseudoinverse is shown to have properties analogous to those which have been used to solve ill-conditioned systems of linear equations. An approximate pseudoinverse is defined, shown to arise from a better conditioned system of equations, and used to obtain a quantity related to the statistical interpretation of the solution when random inaccuracies are added to the original system. The sensitivities of conventional, and approximate matrix pseudoinverse, solutions to an ill-conditioned system are compared in a numerical example. Author (TAB)

N66-37452# Minnesota Univ., Minneapolis. School of Mathematics.
ERGODIC THEORY OF DYNAMICAL SYSTEMS, VOLUME I
A. Avez 1966 182 p refs
(Contract Nonr-3776(00))
(AD-636186) CFSTI: HC $5.00/MF $1.00

Investigated are geodesic flows, Hamiltonian flows and classical systems, abstract dynamical systems, time mean and space mean, ergodicity, the mean sojourn time, mixing, spectral invariants, the discrete spectrum of the classical systems, the Lebesgue spectrum, K-systems, and entropy. In each area, theorems are proved and sample problems are solved. A bibliography of source material on the measure theory, differential geometry, classical mechanics, and algebraic topology is included. H.S.W.

N66-37483# Boeing Scientific Research Labs., Seattle, Wash. Mathematics Research Lab.
THE RODRIGUES OPERATOR TRANSFORM Preliminary Report
T. P. Higgins Dec. 1965 130 p refs *Its* Math Note No. 437
(DI-82-0492; AD-636137) CFSTI: HC $4.00/MF $1.00

The generalized Rodrigues operators introduced include fractional integrals and the Laplace transform. All of the commonly treated special functions can be expressed in terms of these operators. Moreover, the recurrence, differentiation and transformation relations as well as the interrelations with other functions become immediate simple consequences of the calculus of the Rodrigues operators. Using the generalized Parseval relations a great many known integral transforms can be stated as a chain of Rodrigues operators. These include the Hankel, Stieljes, modified Bessel, Neumann, Legendre and hypergeometric transforms. The Rodrigues operators provide a clarification of the essential structure which unifies the relations of integral transforms, special functions and differential operators. This insight yields a technique whereby a new transform or chain or transforms can be tailor made to deal with an arbitrary differential operator. This method has application in a large number of boundary value problems of mathematical physics. Author (TAB)

N66-37467# Institut d'Aeronomie Spatiale de Belgique, Brussels.
AN ITERATIVE METHOD FOR THE SOLUTION OF EIGENVALUE PROBLEMS
M. Godart 1965 18 p refs Submitted for Publication
(A-38-1965) CFSTI: HC $1.00/MF $0.50

A new simple iterative method is developed for the determination of proper elements associated with the solution of Sturm-Liouville problems. The convergence of the iteration process is rapid and each eigenvalue can be estimated independently of all the eigenvalues. The involved accuracy is determined by the method used for the solution of an ordinary first order equation. Author (ESRO)

N66-37593# Nagoya Univ. (Japan). Inst. of Plasma Physics.
ON THE METHOD OF NUMERICAL COMPUTATION OF DISPERSIVE NONLINEAR EQUATION
Akizi Outi and Nobuo Yajima Jun. 1966 16 p refs
(IPPJ-49) CFSTI: HC $1.00/MF $0.50

In order to examine the difference schemes to obtain numerical solutions of dispersive nonlinear equations we consider a model equation which is derived from the Schrödinger equation and is solvable exactly. By comparing the numerical solutions with the corresponding exact solutions we find that Kruskal–Zabusky's scheme applied to the Kortweg—de Vries equation approximates well the exact solution. Author

N66-37601# General Electric Co., Syracuse, N. Y. Radio Guidance Operation.
ON THE INFERENCE OF SYSTEM RELIABILITY—REPORT I: MATHEMATICAL MODEL
David Rubinstein 19 Nov. 1965 38 p refs
(R65RG05)

This report discusses the model for system reliability based on independent exponentially distributed failure times of components. The model is adapted to the usual complexity

of system environment. Some convenient formulas for system reliability are derived. A summary of the entire series of reports is given. Author

N66-37602# General Electric Co., Syracuse, N. Y. Radio Guidance Operation.
ON THE INFERENCE OF SYSTEM RELIABILITY. REPORT IVA: ESTIMATION OF FAILURE RATES IN A DYNAMIC RELIABILITY PROGRAM
David Rubinstein 17 Dec. 1965 69 p refs
(TIS-65RG07)

This report is concerned with the estimation of system failure rates when the available life test data is used both for selecting components and for estimating system reliability. It is shown that the conventional estimates based only on life test data of accepted components are biased. Unbiased estimates are derived for the system failure rate and of the variance of the estimate of the system failure rate. Other topics pertinent to dynamic reliability programs are covered including: various pitfalls in dynamic reliability programs; combination of preselection and postselection data; and design of life tests. All of the formal derivations are related to the sequential selection of components, which is thoroughly discussed. Author

20 METEOROLOGY

Includes climatology; weather forecasting; and visibility studies. For related information see also: 13 Geophysics; and 30 Space Sciences.

N66-36566# McGill Univ., Montreal (Quebec). Arctic Meteorology Research Group.
PROCEEDINGS OF THE (SIXTH) STANSTEAD SEMINAR ON THE MIDDLE ATMOSPHERE Scientific Report No. 2
May 1966 365 p refs Seminar held in Stanstead, Canada, 26 Jul.–6 Aug. 1965 *Its* Publ. in Meteorology No. 80
(Contract AF 19(628)-4955)
(AFCRL-66-369; AD-635390) CFSTI: HC $7.00/MF $1.75

Seminar papers on the energetics and circulation of the stratosphere, ozone and radiation problems, and related tropospheric studies are presented. For individual titles see N66-36567–N66-36586.

N66-36567# London Univ. (England).
THE MIDDLE ATMOSPHERE
F. Kenneth Hare *In* McGill Univ. Proc. of the (6th) Stanstead Seminar on the Middle Atmosphere May 1966 p 1–9 refs (See N66-36566 22-20) CFSTI: HC $7.00/MF $1.75

The middle atmosphere is defined as the layer between 15 km and 80 km, and the usefulness of such a definition to the meteorologist is discussed. Dynamical, physical, photochemical, and chemical reasons for recognizing this layer are treated from the meteorological point of view. Kinetic energy conditions and annual rhythm characteristics in this layer are compared with those of the troposphere and the thermosphere, and the dynamic interactions of these regimes are pointed out. Graphs illustrating climatological findings that are characteristic of the middle atmosphere are included. K.W.

N66-36568# Air Force Cambridge Research Labs., Bedford, Mass.
THE ENERGETICS OF THE WINTER-TIME STRATOSPHERE
H. Stuart Muench *In* Mc Gill Univ. Proc of the (6th) Stanstead Seminar on the Middle Atmosphere May 1966 p 11–35 refs (See N66-36566 22-20) CFSTI: HC $7.00/MF $1.75

Investigated are the so-called sudden warmings or explosive warmings in the stratosphere associated with such events as flooding of the arctic stratosphere with warm air, a vanishing of the zonal westerly current, and the appearance of several cut-off highs and lows. Four energy equations are derived to examine basic boundary processes, energy conversion processes, boundary geopotential motions, and frictional viscous dissipation. In a computational process, the terms of the energy equations are evaluated both before and during a warming observed during January of 1958. Computed values for the different forms of energy in the stratosphere as a function of time are given and compared with results of other investigators. Harmonic analyses were made, with 50N as a representative latitude, using stratospheric and tropospheric data obtained from the surface to 100 mb. The results are discussed and presented in diagrams. K.W.

N66-36569# Toronto Univ. (Ontario).
THE CIRCULATION OF THE STRATOSPHERE
A. W. Brewer *In* Mc Gill Univ. Proc. of the (6th) Stanstead Seminar on the Middle Atmosphere May 1966 p 37–38 (See N66-36566 22-20) CFSTI: HC $7.00/MF $1.75

Discussed in a brief statement are: (1) molecular diffusion and vertical mixing during movement of permanent gases in the stratosphere; (2) seasonal and thermal effects on formation and transport of ozone and on fallout of radioactive debris; and (3) water and the vapor structure as indicators of the transport mechanism. K.W.

N66-36570# McGill Univ., Montreal (Quebec).
WIND REPRESENTATION OVER THE EARTH
Philip E. Merilees *In its* Proc. of the (6th) Stanstead Seminar on the Middle Atmosphere May 1966 p 39–50 refs (See N66-36566 22-20) CFSTI: HC $7.00/MF $1.75

Based on the geopotential height of pressure surfaces, the stream function is generated from the height data, and associated problems are examined. The functions of the normalized surface spherical harmonics are derived for representation of the height data and the resulting stream function. The stream function components are obtained by the linear balance equation. Equations are also given for the mean horizontal kinetic energy and the mean square vorticity, and a factor for error propagation and amplification is established. It is concluded that this method of global wind representation is promising except for a large amplitude of noise in large scale waves, for which a scheme of truncation other than that suggested in this paper is required. K.W.

N66-36571# McGill Univ., Montreal (Quebec).
NON-LINEAR BAROTROPIC INTERACTIONS
Philip E. Merilees *In its* Proc. of the (6th) Stanstead Seminar on the Middle Atmosphere May 1966 p 51–74 refs (See N66-36566 22-20) CFSTI: HC $7.00/MF $1.75

Two simple models of barotropic flow have been studied by use of the technique of Fourier transformation. The results are consistent with previous linear analyses of barotropic flow but also provide insight into the details of non-linear barotropic flow as well as offering a satisfying physical explanation for the results of these analyses. Further, with reference to the application of the technique and ideas generated by

this study, the following points can be made: (1) the non-linear dynamic processes in the atmosphere can be studied in a quasi-analytic fashion with fruitful results; (2) by knowing the details and workings of non-linear processes one can make more satisfying physical explanations of observed phenomena and of the results of previous analyses; and (3) the concepts of stability and instability probably need to be modified to include instability of the non-linear type, especially in the stratosphere, where it is probable that perturbations are converting energy baroclinically but only because large perturbations have been propagated into this region from below.
Author

N66-36572# Michigan Univ., Ann Arbor.
SOME DYNAMICAL EFFECTS OF TOPOGRAPHY AND DIABATIC HEATING
Jacques Derome *In* McGill Univ. Proc. of the (6th) Stanstead Seminar on the Middle Atmosphere May 1966 p 75–81 refs (See N66-36566 22-20) CFSTI: HC $7.00/MF $1.75
(Grant NSF GP-2561)

A model using actual topography and published distribution of diabatic heating is used to study the standing wave problem. The resulting standing waves are compared with those observed in the atmosphere. Two equations, one for vorticity, the other for the first law of thermodynamics, are basically used in the model. In the comparison of computed and observed values, the heights of 25, 50, and 75 cb pressure levels are shown as functions of longitude. The computed and observed values agree at all levels. The amplification or damping of the waves with height is also briefly discussed.
K.W.

N66-36573# Michigan Univ., Ann Arbor.
A DIAGNOSTIC STUDY OF CIRCULATIONS AND DIABATIC HEATING IN THE MERIDIONAL PLANE
A. D. Vernekar *In* McGill Univ. Proc. of the (6th) Stanstead Seminar on the Middle Atmosphere May 1966 p 83–90 refs (See N66-36566 22-20) CFSTI: HC $7.00/MF $1.75
(Grant CWB-WBG-44)

Computation of the mean meridional circulations of the atmosphere was attempted by considering the balance of momentum and heat budgets in the mean state. The use of the simplified form of the vorticity equation in spherical coordinates, which is consistent with the quasi-nondivergent theory and satisfies the integral constraints, is demonstrated. Eddy transfer of zonal momentum and sensible heat were mathematically determined using available data for the region from 20N to 87.5N latitudes at 2.5° intervals at the isobaric levels 85, 70, 50, 30, and 20 cb, for January, April, July, October 1962, and January 1963. Values from the equator to 20N were obtained on the basis of extrapolated data. The thermodynamic equation is rearranged for the zonally averaged diabatic heating. A decrease of heating with height in the lower latitudes and a decrease of cooling with height in the higher latitudes was observed.
K.W.

N66-36574# Department of Transport, Ottawa (Ontario). Meteorological Service of Canada.
SPECTRAL FORMS OF THE METEOROLOGICAL EQUATIONS
Andre J. Robert *In* McGill Univ. Proc. of the (6th) Stanstead Seminar on the Middle Atmosphere May 1966 p 91–107 refs (See N66-36566 22-20) CFSTI: HC $7.00/MF $1.75

Analogical experiments for weather prediction are initially reviewed, followed by a detailed study of the prediction problem. The use of electronic equipment in numerical integrations is discussed, and the role of baroclinic models as a transition stage between the simple barotropic models and the models based on the complete meteorological equations is pointed out. In addition to simulation by grid point representation, the spectral forms of the meteorological equations are treated in detail. Mathematical operations for the numerical integration are performed, and the meteorological application is demonstrated with a model for five levels covering the entire earth. Although seriously oversimplified, the method described in this paper is considered potentially profitable in general circulation experiments or for long range forecasts.
K.W.

N66-36575# Washington Univ., Seattle.
THE CIRCULATION OF THE TROPICAL STRATOSPHERE
Richard J. Reed *In* Mc Gill Univ. Proc. of the (6th) Stanstead Seminar on the Middle Atmosphere May 1966 p 109–133 refs (See N66-36566 22-20) CFSTI: HC $7.00/MF $1.75

Purpose of the study was chiefly to reexamine the circulation of the tropical stratosphere in the light of the extensive data that have appeared since 1954. The following four components of the circulation are discussed: (1) the long term mean component whereby west winds are maintained near the equatorial tropopause; here the replenishment of the westerly momentum is analyzed; (2) the 26-month oscillation, in which zonal wind amplitude and phase, temperature oscillations, and ozone fluctuations are considered; (3) the annual cycle, for which phase and amplitude of zonal winds and temperature fluctuations are shown; and (4) the semi-annual wind and temperature cycles. The difficulties in analyzing the circulation of the tropical stratosphere during conditions at the solstice are mentioned, and the need for applying model and numerical experiments in the investigation of these phenomena is pointed out.
K.W.

N66-36576# Washington Univ., Seattle.
THE ORIGIN AND STRUCTURE OF THE 26-MONTH OSCILLATION
Richard J. Reed *In* Mc Gill Univ. Proc. of the (6th) Stanstead Seminar on the Middle Atmosphere May 1966 p 135–161 refs (See N66-36566 22-20) CFSTI: HC $7.00/MF $1.75

In view of the longitudinal independence of the oscillation, the zonally averaged forms of the hydrodynamic equations are used in diagnosing its structure. Specifically, the momentum equations in the three coordinate directions, the equation of continuity, the thermodynamic energy equation, and the ozone balance equation are applied to the 26-month oscillating component of motion. Variations in temperature, vertical motion, ozone concentration, and meridional velocity are derived. Solutions at several different levels are given in form of harmonic dials; all solutions pertain to the equator except the meridional wind solution, which applies to 15°N. Phase relationships for the upper levels are shown schematically. A zonal momentum equation is given for investigating the momentum balance at the equator. The origin study consists mainly of a review and critical analysis of the approaches and findings of other investigators. The current stand of knowledge regarding structure and origin is summarized in conclusion.
K.W.

N66-36577# McGill Univ., Montreal (Quebec).
A MODEL OF THE STRATOSPHERE WITH DIABATIC HEATING, VARIABLE OZONE AND DYNAMICAL FORCING FROM BELOW
R. A. D. Byron-Scott *In its* Proc. of the (6th) Stanstead Seminar on the Middle Atmosphere May 1966 p 163–194 refs (See N66-36566 22-20) CFSTI: HC $7.00/MF $1.75

Progress in the design of a numerical model for the region consisting of the middle and upper stratosphere and the first few kilometers of the mesosphere is described. In the model, ozone is produced or destroyed at a rate depending upon temperature, available solar radiation, and the amount of

ozone already present; diabatic heating is assumed to be due solely to absorption of solar radiation by ozone and exchange of long wave radiation by CO_2 and ozone. An extensive review of work by other authors is made in seeking a scaling of the equations of motion appropriate to the planetary waves and in deriving the equations of motion and continuity, the thermodynamic equation, and the ozone equation. Tidal effects are eliminated from the thermodynamic and ozone equations that are relevant to meteorological disturbances. The choice of levels and the upper and lower boundary conditions are discussed in defining the vertical structure of the model. Radiative considerations include the short-wave heat source term, dissociation rates of oxygen and ozone, and the calculation of source sink term components. Methods for integrating the model and experiments to be performed are discussed. K.W.

N66-36581# Weather Bureau, Washington, D. C.
THE IQSY STRASTOSPHERIC MAP SERIES
Frederick G. Finger and Harold M. Woolf *In* Mc Gill Univ. Proc. of the (6th) Stanstead Seminar on the Middle Atmosphere May 1966 p 233–251 refs Sponsored by NASA, AEC, USN, and NSF (See N66-36566 22-20) CFSTI: HC $7.00/MF $1.75

The daily operational computer analyses of stratospheric constant pressure charts during the International Quiet Sun Year (IQSY) are discussed. The discussion covers automatic data processing of available stratospheric data, the monitoring of input data processing of available stratospheric data, the monitoring of input data, the system for analyzing stratospheric charts, and a study of stratospheric constant pressure charts for January 6, 1965. The charts produced by the computer system are considered comparable in quality to subjective stratospheric analyses. K.W.

N66-36582# Freie Univ., Berlin (West Germany).
A SYNOPTIC STUDY OF THE STRATOSPHERIC CIRCULATION ABOVE 30 KILOMETERS
Guenter Warnecke *In* Mc Gill Univ. Proc. of the (6th) Stanstead Seminar on the Middle Atmosphere May 1966 p 253–284 refs (See N66-36566 22-20) CFSTI: HC $7.00/MF $1.75

The purpose of this work is to demonstrate the present and near future data potential above 30 km and to encourage vertical extension of radiosonde observation. The current stand of meteorological radiosonde observations is reviewed, and a survey of the stratospheric circulation within the 35 km to 45 km region for 1963 is presented. Equipment, procedures, and results of the daily ascents at the Berlin, Germany, radiosonde station, which since 1960 have exceeded an annual mean peak altitude of 30 km, are described. Absolute topography charts of 5 mb and 2 mb surfaces for given dates are included in the presentation. K.W.

N66-36583# Freie Univ., Berlin (West Germany).
THE UTILITY OF SATELLITE-BORNE RADIOMETRIC MEASUREMENTS FOR STRASTOSPHERIC RESEARCH
Guenter Warnecke *In* Mc Gill Univ. Proc. of the (6th) Stanstead Seminar on the Middle Atmosphere May 1966 p 285–292 refs (See N66-36566 22-20) CFSTI: HC $7.00/MF $1.75

This brief presentation aims to give new evidence for the high potentiality of radiometric measurements in describing global midstratospheric phenomena and to indicate how to interpret these data as strastospheric temperatures. Specifically discussed are results obtained with the medium resolution radiometer of Tiros VII in measuring the atmospheric radiation within the 15 micron CO_2 band, for which maximum contributions are shown to come from layers around 23 km to 25 km. The correlation between the Tiros VII measurements and the global mid-stratospheric 30 mb temperature pattern is demonstrated. K.W.

N66-36584# National Aeronautics and Space Administration, Goddard Space Flight Center, Greenbelt, Md.
RECENT OBSERVATIONS OF THE STRUCTURE OF THE UPPER STRATOSPHERE AND MESOSPHERE
W. Nordberg *In* Mc Gill Univ. Proc. of the (6th) Stanstead Seminar on the Middle Atmosphere May 1966 p 293–323 refs (See N66-36566 22-20) CFSTI: HC $7.00/MF $1.75

Temperature structures, pressure distributions, and wind patterns obtained with grenade rocket soundings at various latitudes in the Atlantic and North American region during the period of minimum solar activity are analyzed. Times and locations of all soundings are given, and latitudinal and seasonal variations and their relationship to the basic physical processes governing the stratosphere and mesosphere are emphasized in the evaluation. The results are also compared with data obtained during maximum solar activity. K.W.

N66-36585# Department of Transport, Ottawa (Ontario). Meteorological Service of Canada.
A NUMERICAL MODEL FOR 3 DAY FORECASTS
D. E. Mc Clellan *In* Mc Gill Univ. Proc. of the (6th) Stanstead Seminar on the Middle Atmosphere May 1966 p 325–331 refs (See N66-36566 22-20) CFSTI: HC $7.00/MF $1.75

Theory and predictive equations for the numerical model are briefly given, and a case study of predictions of 24 hour thickness based on two different models is presented. The results for the prediction date, January 25, 1965, are found to be reasonably typical of those obtained during the winter months. K.W.

N66-36586# Department of Transport, Ottawa (Ontario). Meteorological Service of Canada.
METEOROLOGICAL DATA PROCESSING—DATA PROBLEMS
M. Kwizak *In* Mc Gill Univ. Proc. of the (6th) Stanstead Seminar on the Middle Atmosphere May 1966 p 333–343 refs (See N66-36566 22-20) CFSTI: HC $7.00/MF $1.75

A summary is presented of the views expressed at the symposium on Meteorological Data Processing at Brussels, 2–5 July 1965. The major problems related to meteorological data processing are discussed under the following headings: (1) global observation network; (2) communications and codes; (3) archiving, storage, and retrieval; (4) use of synoptic and processed data; (5) preprocessing of instrument error; (6) arrangement of data for dynamical studies; and (7) world weather watch. Recommendations of the participants of the symposium are given in conclusion. K.W.

N66-36587# Joint Publications Research Service, Washington, D. C.
METEOROLOGICAL OBSERVATIONS FROM MANNED SPACECRAFT
K. Ya. Kondrat'yev 15 Sep. 1966 28 p refs Transl. into ENGLISH from Fiz. Atmosfery i Okeana (Moscow), v. 2, no. 7, 1966 p 740–757
(JPRS-37651; TT-66-34079) CFSTI: $1.00

Previous data obtained from meteorological investigations are reviewed, and a discussion is presented on the analysis of visual observations, motion pictures, and photog-

raphy of the earth from outer space. Data from photographs of the cloud cover are discussed, and some type examples are reproduced. Investigations of the optical heterogeneity of the troposphere and the stratosphere are also mentioned. R.Ll.

N66-36602# Texas Univ., Austin. Antennas and Propagation Div.

A COMPARISON OF THEORETICAL AND EXPERIMENTAL ELECTROMAGNETIC SCATTERING CHARACTERISTICS OF A METEOROLOGICAL RADAR ANGEL MODEL

W. N. Kocurek and A. H. La Grone 10 Jun. 1966 69 p refs (Grant NSF GP-2596)
(P-7)

Coherent-dot radar angels are reflectors of radar energy which exist in the lower troposphere but remain invisible to the aided eye. Both particulate matter and meteorological phenomena have been postulated as likely angel sources. The meteorological model studied is representative of the cap of an atmospheric thermal or pre-cloud. Expressions derived by physical optics for the radar cross-section of the model are numerically evaluated, and the results are compared with experimentally obtained data. Comparisons are made for both limiting values of scatterer radius of curvature. In each case, theoretical plots of monostatic cross-section as a function of radar elevation angle exhibit a peak, a few tenths of a degree in width, at an elevation angle of ninety degrees. Similar plots of experimental data, however, exhibit peaks which are several tens of degrees wide. This discrepancy, coupled with other factors, is discussed. Then, on the basis of this study, it is concluded that the model cannot be reconciled as a valid radar angel source. Author

N66-36891# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.

THE AMOUNT OF SUMMER LIGHTNING OVER THE EUROPEAN USSR

N. I. Leushin 25 May 1966 18 p Transl. into ENGLISH from Meteorol. i Gidrol. (Moscow), no. 9 1964 p 22-28
(FTD-TT-65-1798; TT-66-61789; AD-635827) CFSTI: HC $1.00/MF $0.50

The article describes a method of constructing charts of lightning distribution over the European USSR on the basis of data obtained during the period 1958-1960 by means of the European cluster of direction-finding equipment. Characterizing thunderstorm activity not by the number of thunderstorm days, but by the number of lightning strokes in the examined territory is proposed. The direction-finding method makes it possible to obtain charts of the average distribution of discharges in various periods. These charts make it possible to trace the development of thunderstorm activity during a day. TAB

N66-37089# Honeywell, Inc., St. Paul, Minn. Research Dept.

STUDY OF LOW FREQUENCY ELECTRICAL CHARACTERISTICS OF CLEAR AIR TURBULENCE AND STORM FRONT CENTERS Final Report, 15 Mar.-15 Sep. 1965

Henry W. Ten Broek and Charles R. Seashore Feb. 1966 120 p refs *Its* Rept.-12011-FR1
(Contract AF 19(628)-5060)
(AFCRL-66-240; AD-636050) CFSTI: HC $4.00/MF $1.00

This report covers work done in investigating the low frequency electrostatic field characteristics of clear air turbulence and storm front regions. The general theory describing the field sensing antennas is presented in addition to the practical aspects of those antennas actually utilized in the program. The electronic instrumentation used in data gathering flights and subsequent data reduction is described; and the data from one ridgeline turbulence encounter and three storm front flights are analyzed with respect to frequency content in decade bandwidths from 0.1 to 10,000 cps. Results from the turbulence flight reveal signals due to the turbulence which differ from pre- and post-encounter norms, and present the possibility of anticipating the encounter. Author (TAB)

N66-37103# Joint Publications Research Service, Washington, D. C.

DOPPLER RADAR MEASUREMENTS OF TURBULENCE IN PRECIPITATIONS

Yu. V. Mel'nichuk 16 Sep. 1966 18 p refs Transl. into ENGLISH from Fiz. Atm. i Okeana (Moscow), v. 2, no. 7, 1966 p 695-704
(JPRS-37660; TT-66-34088) CFSTI: $1.00

A doppler radar is used to measure the pulsations of horizontal components of wind velocity in rain and snow. The scale of averaging of velocity pulsations is estimated using the radar as a measurer of the wind. Computed from the measurement data are the time functions of the correlation and the structure functions of the longitudinal and lateral wind velocity components in weakly unstable or neutral stratification of the atmosphere. Using a multichannel system for discriminating and processing the radar signal, spatial correlation functions of the longitudinal wind speed component are measured at altitudes up to 250 meters. Good agreement of spatial and time correlation functions has been obtained. From the same measurements, mixed spatial-time correlation functions are calculated. Analysis of these functions shows that the spatial structure of pulsations of wind velocity with their transfer by an average current is stable, and is preserved during a time interval which is many times greater than the time for correlation of pulsations measured at a fixed point in space. Author

N66-37165# White Sands Missile Range, N. Mex. Atmospheric Sciences Lab.

NIKE-APACHE STV (SR-032) (2 JUNE 1966) Meteorological Data Report

Gordon L. Dunaway Jul. 1966 32 p
(DR-41; AD-485273)

Meteorological data gathered for the launching of Nike-Apache STV (SR-032) are presented for the Ballistic Systems Division, U.S. Air Force, and for future ballistic studies. The meteorological data and resulting ballistic data appear in tabular form. Author (TAB)

N66-37205# California Univ., Los Angeles. Dept. of Meteorology.

ON THE PARTITIONING OF THE BAROCLINIC VERTICAL MOTIONS IN A DEVELOPING WAVE CYCLONE Scientific Report No. 1

T. N. Krishnamurti, Julia Nogues, and Dave Baumhefner May 1966 61 p refs
(Contract AF 19(628)-4777)
(AFCRL-66-419; AD-636254) CFSTI: HC $3.00/MF $0.75

The simple quasi-geostrophic or a more general W-equation of a balanced model can be used in a unique manner to partition the vertical velocities. A study of such a partitioning determines the contributions by several baroclinic processes that are somewhat hard to see from a mere visual examination of the pressure and thermal fields on synoptic weather maps. The results of the quasi-geostrophic partitioning show that the thermal advection and its contribution are quite large even at the open wave stage. This is contrary to Pettersen's (1956) views that upper vorticity advection initiates the development of an open wave. The results are in agreement with

the linear stability analysis of Phillips (1954) and Ogura (1956). The results of the multi-level baroclinic balanced model determines the importance of some of the terms that are absent in the quasi-geostrophic theory and that are rather large during the life history of a wave cyclone. Large magnitudes to the baroclinic vertical motions are contributed by a part of the divergence term in the vorticity equation which is neglected in the quasi-geostrophic models. Contributions by the deformation terms of the balanced stream function are also large and contribute significantly to the storm dynamics during its growth. A multi-level diagnostic balance model is demonstrated as a powerful tool for studying three dimensional details of the non-geostrophic behavior of the atmosphere during various stages of a storm development. Author (TAB)

N66-37241# White Sands Missile Range, N. Mex. Atmospheric Sciences Lab.
HONEST JOHN, MISSILE NO. 43, ROUND NO. 524 RML (21 JUNE 1966) Meteorological Data Report
Jul. 1966 22 p
(DR-46; AD-635590) CFSTI: HC $6.00/MF $0.50

Meteorological data gathered for the launching of Honest John, missile number 43, round no. 524 RML, are presented in tabular form. Author (TAB)

N66-37242# White Sands Missile Range, N. Mex. Atmospheric Sciences Lab.
HONEST JOHN, MISSILE NO. 40, ROUND NO. 523 RML (8 JUNE 1966) Meteorological Data Report
Jul. 1966 16 p
(DR-42; AD-635589) CFSTI: HC $1.00/MF $0.50

Meteorological data gathered for the launching of Honest John, missile number 40, round no. 523 RML, are presented in tabular form. Author (TAB)

N66-37265# Oklahoma Univ. Research Inst., Norman. Atmospheric Research Lab.
A CONSIDERATION OF SOME OF THE FACTORS AFFECTING ATMOSPHERIC COMPOSITION, STATIC STABILITY AND MOTION BETWEEN 20 AND 100 km Final Report, 1 Mar. 1965–30 Mar. 1966
V. S. Whitehead, M. D. Miller, and W. J. Saucier Apr. 1966 90 p refs
(Contract AF (19(628)-4767)
(ARL-1489-1; AFCRL-66-333; AD-635977) CFSTI: HC $3.00/MF $0.75

The equilibrium concentrations of atomic oxygen and ozone between 30 and 80 kilometers as a function of zenith angle were computed. The time change of these constituents after darkness were computed for the case of no outside source of ozone and atomic oxygen and for the case where diffusion or mixing kept the supply of atomic oxygen at one percent of the sundown value. Regions of the mesosphere which should support enhanced mixing are determined by considering the distribution of density as a function of altitude, latitude, and time of year. Figures depicting the regions of preferred relative maximum of mixing are included. The effects that coriolis force and viscous forces have on upper mesospheric and lower thermospheric winds are shown. It is demonstrated that viscous forces can generate a wave form in an atmosphere driven by periodic motion at the top, and it is shown that the coriolis effect can cause an apparent upward or downward propagation of an existing wave form. Author (TAB)

21 NAVIGATION

Includes guidance; autopilots; star and planet tracking; inertial platforms; and air traffic control. For related information see also: 07 Communications.

N66-36558# ITT Federal Labs., Inc., San Fernando, Calif.
THE FINE GUIDANCE SENSOR, AN ELECTRONIC SCANNING STAR TRACKER
R. A. Deters, D. F. Eisenhut, and R. F. Gates *In* Canaveral Council of Tech. Soc. 3d Space Congr. 1966 p 621–628 (See N66-36506 22-30)
(Contract NAS2-1153)

The advent of space exploration has placed hitherto unheard of requirements on accuracy and precision sensing devices for guidance and attitude control. The necessity for high reliability, due to non-repairability, required new approaches to this design problem. Rather than try to improve upon existing systems, components, and approaches, a totally new concept evolved which eliminates the mechanical rotors and reticles of yesterday. Instead, a totally new breed of electronic scanning star sensor resulted. This paper describes one such device, a Boresighted Star and Planet Tracker developed for precise attitude sensing and control of an experimental sounding rocket. Discussed are the major elements of the basic sensing system, optics, detector, and electronics. The heart of the new sensor is the electronic scanning multiplier phototube, a small, rugged, highly accurate and highly reliable device. Electronic circuit design to enhance accuracy and precision is outlined. Author

N66-36562# TRW Systems, Redondo Beach, Calif.
NAVIGATION FOR SPIN STABILIZED DEEP SPACE PLANETARY SPACECRAFT
R. A. Park and D. H. Newell *In* Canaveral Council of Tech. Soc. 3d Space Congr. 1966 p 656–686 ref (See N66-36506 22-30)

Control system requirements and onboard navigation tasks may be minimized if spin stabilized navigation systems are used on spacecraft for deep space planetary missions, i.e. missions to Jupiter and Pluto. It is noted however, that a number of problems must be solved before this tecnique can be successfully adapted. The system used for the Pioneer VI spacecraft is examined and a method for modifying the system for a mission beyond the orbit of Jupiter is discussed. Additional spin stabilized configurations are considered, and spacecraft command capabilities at long ranges are assessed. H.S.W.

N66-37035*# National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.
INTERPLANETARY MIDCOURSE GUIDANCE USING RADAR TRACKING AND ON-BOARD OBSERVATION DATA
Luigi S. Cicolani Washington, NASA, Sep. 1966 55 p refs
(NASA-TN-D-3623) CFSTI: HC $2.00/MF $0.50 CSCL 17G

The performance of midcourse guidance and navigation systems for manned interplanetary missions are examined for when radar range and range-rate measurements and on-board theodolite observations are available as sources of navigation data. Results are given for two Mars missions. Reasonable observation schedules to refine the miss estimate to the accuracy required for entry or close approach are found to consist primarily of radar

observations, plus frequent on-board observations of the target planet during the approach to Mars or Venus, or radar observations during the approach to the Earth. The system performance is such that the miss is generally estimated better than it can be controlled. Consequently, the work of Lawden can be applied to obtain an analytical solution for the a priori optimum correction schedule. Results of optimum four-correction schedules used in the simulations on all legs of the two missions agree fairly well with the theory. The velocity-correction requirements for the various legs range from 18 to 24 m/sec, and the rms miss in pericenter radius at arrival is less than 2.8 km at Earth and Mars and 6 km at Venus. The downrange miss varies from 2 to 22 km. Author

22 NUCLEAR ENGINEERING

Includes nuclear reactors and nuclear heat sources used for propulsion and auxiliary power. For basic research see: 24 Physics, Atomic, Molecular, and Nuclear. For related information see also: 03 Auxiliary Systems; and 28 Propulsion Systems.

N66-36564# Comitato Nazionale per l'Energia Nucleare, Frascati (Italy). Laboratori Nazionali di Frascati.

COMPENSATION FOR THE EFFECTS OF DISCORD IN THE RESONANT CAVITIES OF ACCELERATORS [COMPENSAZIONE DEGLI EFFETTI DEL DISACCORDO NELLE CAVITA' RISONANTI DELLE MACCHINE ACCELERATRICI]

D. Fabiani and M. Puglisi 24 May 1966 25 p refs In ITALIAN its Nota. Interna. No. 322
(LNF-66/28) CFSTI: HC $2.00/MF $0.50

The control system described is considered satisfactory since it compensates almost entirely for discord effects on the amplitude and on the outgoing phase voltage. Based on phase measurements, this system does not function for variations in voltage from causes external to the discord and, herefore, permits the regulation of the voltage of the resonators without engaging the control system. Electronic circuit diagrams depict the amplification-resonance group, and the phase descriminator. The control system for the Adone radio frequency system is shown in a block diagram. A mathematical discussion is also presented on the correction circuit, and a mathematical model and another block diagram for the functioning of the entire system. R.Li.

N66-36732# Centre d'Etude de l'Energie Nucleaire, Mol (Belgium).

IRRADIATION DAMAGE IN BERYLLIUM OXIDE

A. Buerkholz Brussels, EURATOM, Jul. 1966 30 p refs
(Contract EURATOM-006-60-5 BRAB)
(EUR-3054-e) CFSTI: HC $2.00/MF $0.50

A synthesis has been made from the most important of the available publications on irradiation damage in beryllium oxide, and references of the articles are given. Major irradiation series started in 1961 and are still in progress. The principal radiation effect is growth and fracturing of the BeO specimens. The higher the irradiation temperature, the higher the dose required to start damage. Equally important is the fabrication history of the material, small grain size being favorable for radiation resistance. It is not yet possible to find experimentally an influence of the dose rate on radiation damage. Provided that the right irradiation conditions are chosen, beryllium oxide should withstand much higher doses than formerly expected. Author

N66-36733# Centre d'Etude de l'Energie Nucleaire, Mol (Belgium).

IRRADIATION DAMAGE IN BERYLLIUM

A. Buerkholz Brussels, EURATOM, Jul. 1966 29 p refs
(Contract EURATOM-006-60-5 BRAB)
(EUR-3055.e) CFSTI: HC $2.00/MF $0.50

A review is presented of the most important publications on irradiation damage in beryllium, and references of the articles are given in the bibliography. An irradiation effect characteristic to beryllium is the production of He-atoms by fast neutrons. Principal irradiation damage is the severe embrittlement of the material after exposure to high doses. At temperatures above 600°C, bubble formation at grain boundaries leads to extensive swelling of the beryllium. Author

N66-36734# Centre d'Etude de l'Energie Nucleaire, Mol (Belgium).

IRRADIATION DAMAGE IN GRAPHITE

A. Buerkholz Brussels, EURATOM, Jul. 1966 34 p refs
(Contract EURATOM-006-60-5 BRAB)
(EUR-3056.e) CFSTI: HC $2.00/MF $0.50

From a number of easily available reports dealing with the radiation effects on graphite, we tried to trace a picture of the behavior of graphite under irradiation. Although this review is not complete, it covers the main radiation effects and it makes available information on this vast and complicated subject. Due to the complicated structures of the graphite materials, reviews on radiation damage on graphite have very often been compilations of experimental data. Author

N66-36842# RAND Corp., Santa Monica, Calif.

ELEMENTARY INTRODUCTION TO ISOTOPE SEPARATION

Dennis Holliday and Milton S. Plesset Jun. 1966 38 p refs
(Contract AF 49(638)-1700; Proj Defender)
(RM-4938-PR; AD-635643) CFSTI: HC $2.00/MF $0.50

A discussion of six isotope separation processes: (1) the separation nozzle, (2) sweep diffusion, (3) thermal diffusion, (4) electromagnetic separation, (5) gaseous diffusion, and (6) centrifugation. The emphasis is on the physical principles involved in each process and on the use of these physical differences. Because five of the processes involve devices that give individually a very small separation, a cascade of these devices is required to effect large separations. The steady-state theory of such cascades is also discussed. TAB

N66-36907# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.

PROBLEMS OF DOSIMETRY AND RADIATION SHIELDING Selected Articles

16 Feb. 1966 32 p refs Transl. into ENGLISH from Inzhenerno-Fiz. Inst. (Moscow), Issue 2, 1963 p 28–39, 66–77
(FTD-MT-65-30; AD-635279) CFSTI: HC $4.00/MF $0.50

CONTENTS:

1. EXPERIMENTAL INVESTIGATIONS OF DISTRIBUTION FUNCTIONS OF POINT MONODIRECTED SOURCES WITH INITIAL γ-QUANTA ENERGY OF 0.661 AND 1.25 MEV IN CONCRETE, ALUMINUM, IRON, AND LEAD L. R. Kimel', A. M. Panchenko, V. I. Polyakov, and V. P. Terent'yev p 1–11 refs (See N66-36908 22-22)

2. THE SPECTRAL-ANGULAR DISTRIBUTION OF γ-RADIATION FROM THE SURFACE OF A HALF-MEDIUM WITH EVENLY DISTRIBUTED ISOTROPIC SOURCES V. V. Pavlov p 12–26 refs (See N66-36909 22-22)

N66-36908# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.

EXPERIMENTAL INVESTIGATIONS OF DISTRIBUTION FUNCTIONS OF POINT MONODIRECTED SOURCES WITH INITIAL γ-QUANTA ENERGY OF 0.661 AND 1.25 MeV IN CONCRETE, ALUMINUM, IRON, AND LEAD

L. R. Kimel', A. M. Panchenko, V. I. Polyakov, and V. P. Terent'yev *In its* Probl. of Dosimetry and Radiation Shielding 16 Feb. 1966 p 1-11 refs (See N66-36907 22-22) CFSTI: HC $4.00/MF $0.50

The point monodirected sources of gamma radiation were Cs^{137} (0.661 MeV) and Co^{60} (1.25 MeV). A schematic of the iron assembly and the collimating device is described. Assemblies made of concrete, aluminum, and lead were analagous to the iron assemblies. A small-size halogen β-counter with a specially selected shield was used as a detector. Pulses from the counter were recorded with the help of a recalculation installation with stabilized feed. Graphs of the distribution functions for concrete, iron, and aluminum using the Cs^{137} source are discussed and compared to graphs of the same materials made with the Co^{60} source. Experiments using the Cs^{137} source were not conducted on lead due to insufficient activity of the source, but were made with the Co^{60} source. It is pointed out that the data obtained can be used to solve problems about radiation fields for sources with arbitrary angular distribution. E.A.O.

N66-36909# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.

THE SPECTRAL-ANGULAR DISTRIBUTION OF γ-RADIATION FROM THE SURFACE OF A HALF-MEDIUM WITH EVENLY DISTRIBUTED ISOTROPIC SOURCES

V. V. Pavlov *In its* Probl. of Dosimetry and Radiation Shielding 16 Feb. 1966 p 12-26 refs (See N66-36907 22-22) CFSTI: HC $4.00/MF $0.50

The spectral-angular distribution of radiation from the surface of a half-medium is compared with the distribution in an infinite medium. For an infinite medium, an expression is derived for spectral-angular distribution of scattered radiation intersecting a given area of the cross section. Expressions are formulated for single and multiple collisions of gamma quanta, and a relationship is derived which describes the spectral-angular distribution of scattered gamma radiation for gamma quanta in a given interval of energies. The relationship expresses the cosinusoidal law for radiation intersecting an element of area in an infinite medium. In comparing the representation of the function of spectral-angular distribution of radiation from the surface of a half-medium, it is shown that the angular dependence of this function is not strictly cosinusoidal. However, it is stated that in many calculations of the dose of gamma radiation created by active half-volume sources, the spectral-angular distribution of an infinite medium may be used in place of the distribution of the half-medium, with no great error. E.A.O.

N66-36956# Los Alamos Scientific Lab., N. Mex.

ADVANCED REACTOR TECHNOLOGY (ART) Quarterly Status Report, Period Ending April 30, 1966

May 1966 68 p refs
(Contract W-7405-ENG-36)
(LA-3524) CFSTI: HC $3.00/MF $0.75

Further developments in the various components of the Fast Reactor Core Test Facility are described. Some of the cores of the FRCTF are briefly described. Containers for the molten Pu-Co-Ce fuels were tested. Corrosion tests were made on carburized and uncarburized Ta, Ta-W, Ta-W-Y, Nb-Zr, and Nb-W alloys. The tensile properties of uncarburized and carburized Ta-W alloys are given. Burst tests were made on several of the containers. Other brief discussions of various supporting research are presented. NSA

N66-36995# Oak Ridge National Lab., Tenn.

BUILD-UP FACTORS: COEFFICIENTS OF THE EQUATION OF J. J. TAYLOR

S. Buscaglione and R. Manzini [1965] 12 p refs Transl. into ENGLISH of Comitato Nazl. per l'Energia Nucl. Rept. No. RT-FI(65)7, Jan. 1965
(ORNL-TR-80, Rev.)

Build-up factor's coefficients of J. J. Taylor equation were determined, for some of the most common materials for the construction of gamma shielding. The materials investigated are: H_2O, Al, Fe, Pb, Sn, W, U; as well as ordinary concrete, barites concrete, ferrophosphorus concrete and magnetite concrete. Author (NSA)

N66-37069# Edgerton, Germeshausen and Grier, Inc., Santa Barbara, Calif.

NEUTRON AND GAMMA DOSIMETRY MEASUREMENTS AT THE AFRRI-DASA TRIGA REACTOR

J. A. Sayeg, comp. Bethesda, Md., Armed Forces Radiobiol. Res. Inst., Nov. 1965 177 p refs
(Contract DA-49-146-XZ-226)
(S-260-R; AFRRI-CR-65-6; AD-635819) CFSTI: HC $5.00/MF $1.00

Topics include: fast neutron dosimetry (threshold detectors Pu^{239}, (surrounded by B^{10}), Np^{237}, U^{238} and S^{32}, Hurst proportional counter, tissue equivalent and graphite-CO_2 ionization chambers); gamma ray dosimetry (silver phosphate glass rods, graphite CO_2 ionization chamber, tetrachloroethylene chemical dosimeters); thermal neutron dosimetry (bare and cadmium covered gold and indium foils.). TAB

N66-37140*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.

EXPERIMENTAL NEUTRON FLUX ALBEDO FOR CONCRETE

James A. Kish, Ira T. Myers, and John J. Smithrick Washington, NASA, Sep. 1966 18 p refs
(NASA-TM-X-1287) CFSTI: HC $1.00/MF $0.50 CSCL 18F

Thermal neutron flux albedo for concrete due to an incident fast-neutron beam is of interest in predicting activation of a nuclear-rated space chamber. Some measurements of this quantity were made for limestone concrete by using plutonium-beryllium and reactor-beam neutron sources. In both cases, measurements were made by using a moving-detector technique to perform the integration of emergent thermal neutron flux. The accuracy of results for the reactor source was limited by lack of beam-spectrum data, but a value of flux albedo for the PuBe source was determined to be 0.13 ± 0.04. Author

N66-37234# Naval Research Lab., Washington, D. C.

IRRADIATION EFFECTS ON REACTOR STRUCTURAL MATERIALS Quarterly Progress Report, 1 Feb.-30 Apr. 1966

Lendell E. Steele, J. Russell Hawthorne, and Charles Z. Sterpan, Jr. 15 May 1966 63 p refs
(Contract AT(49-5)-2110)
(NRL-MEMO-1700; AD-635844) CFSTI: HC $3.00/MF $0.75

The investigation includes the following: (1) the relative radiation sensitivity of A302-B steels prepared by special melting and heat treatment practice, (2) the evaluation of nickel content as a radiation sensitivity variable, (3) comparative-irradiation enbrittlement of selected higher strength steels, and (4) the effect of neutron spectra upon the observed changes in the notch ductility of irradiated steels. Author

N66-37315*# Catholic Univ. of America, Washington, D. C.
A FUNDAMENTAL AND FEASIBILITY STUDY OF RING-VORTEX GASEOUS-CORE CAVITY REACTOR Fifth Semiannual Report, 1 Feb.–31 Jul. 1966
C. C. Chang 1 Aug. 1966 19 p refs
(Grant NsG-586)
(NASA-CR-78048) CFSTI: HC $1.00/MF $0.50 CSCL 18I

The progress made in understanding the flow pattern in three types of reactor models is summarized. The models studied were the cylindrical geometry, toroidal geometry, and a two dimensional improvement on the Lewis Coaxial Core Reactor. It was found that the square step end walls of equal diameters are definitely promising in reducing secondary flow loss in the cylindrical model. The great advantage of toroidal geometry is the fluid vortex ring which has no open ends; therefore, the secondary flow loss can be eliminated. It is stated that further study is required on the two dimensional model. Abstracts of papers on radiative transfer for parallel streams of radiating gases, mass transfer between two parallel streams, and the stability of Helmholtz flow are also included. H.S.W.

N66-37328# Atomics International, Canoga Park, Calif.
SNAP-10A ELECTRICALLY ACTUATED BAND RELEASE DEVICE SEABOARD DEVELOPMENT Summary Report
I. H. Kranz, R. J. Adams, and R. H. Prowett 24 Nov. 1965 67 p refs
(Contract AT(11-1)-GEN-8)
(NAA-SR-MEMO-11454) CFSTI: HC $3.00/MF $0.75

The EABRD development program has resulted in the selection of the single tube René 41 housing with the one-piece heater bobbin and the U-bolt cable restraint as the reference design. The high strength housing consists of a thin-walled tubular section with attachment fittings at either end for connection to the reflector retainer band lugs. The heater consists of a tungsten wire element wound on a ceramic bobbin. Electrical current is delivered to the heater element by a high temperature shielded cable. Actuation occurs when the internal heater is energized and raises the temperature of the tubular section to its fusion temperature. The configuration studies and materials evaluations which lead to the final design selection are described. Design verification tests were performed to establish confidence that the reference design EABRD would successfully meet the SNAP 10A Qualification Test requirements. These tests include the following: (1) firing tests, (2) tensile tests, (3) dynamic load tests, (4) thermal-vacuum endurance tests, (5) maximum no-fire current tests, and (6) irradiation tests. Based on the results of these tests, the reference design EABRD appears to satisfy the SNAP 10A system requirements. Author (NSA)

N66-37329# Battelle-Northwest, Richland Wash. Pacific Northwest Lab.
RADIATION EFFECT IN GRAPHITE AT HIGH TEMPERATURES
J. W. Helm 4 Jun. 1965 25 p refs
(Contract AT(45-1)-1830)
(BNWL-SA-67) CFSTI: HC $1.00/MF $0.50

Graphite irradiations are being conducted in the temperature range from 800 to 1200°C to determine neutron effects on dimensional stability. Several types of raw-coke and isotropic graphites were also studied at 500 to 1150°C. Data are presented in tables and graphs. The length changes of graphites tested over the temperature range from 450 to 1200°C showed a dependence on the temperature of irradiation, particularly in the parallel direction. The transverse sample irradiated at 1200°C contracted more than those irradiated at 800°C and about the same as samples irradiated at 450°C. Those irradiated at 1000°C contracted at the highest rate. The raw-coke graphites contracted less than the other graphites and in some cases expanded. It appeared that the binder phase has an effect on the amount of physical distortion induced by irradiation. The irradiation expansion was not annealed out by heating above the irradiation temperature, but continued to expand. It was concluded that in an anisotropic graphite containing a large amount of less-graphitic material the expansion of the crystallites in the c direction becomes a controlling factor in physical property changes. NSA

N66-37338# Atomics International, Canoga Park, Calif.
BRITTLE FAILURES OF CARBON STEEL TUBES
R. A. Winborne 15 Nov. 1965 15 p refs
(Contract AT(11-1)-GEN-8)
(NAA-SR-MEMO-11707) CFSTI: HC $1.00/MF $0.50

Information from case histories is presented pertaining to brittle (thick-edge) failures of low-carbon steel tubes in pressure boilers operating at temperatures of 600 to 1000°F and pressures of 450 to 2700 psi. A theory development is included, which is an extension of Dr. E. P. Partridge's methane theory. Six major factors are believed to be involved in initiation and subsequent progress of a crack advancing through a tube wall: initial tube damage, corrosion, decarburization, methane production, tensile (hoop) stress, and the direct action of tube internal pressure on crack wall surfaces. Tube failure could occur in the manner outlined below. Tube embrittlement starts with corrosion of interior (water side) surfaces producing hydrogen. Methane is produced by reaction of hydrogen with carbon in steel near the corroding surface. Microfissures along grain boundaries, enlarged by methane pressure, propagate to the corroding surface. Crevice corrosion produces pitting of this surface. Ligaments between fissures are destroyed by corrosion, and embittlement extends through the tube wall. The weakened tube section eventually is partially cracked by tensile (hoop) stress. Hoop stress and the direct action of tube internal pressure then contribute to fissure rim stress concentration to enlarge fissures ahead of the crack moving through the tube wall. Rupture occurs and the crack extends in an axial direction the length of the embrittled tube section. Author (NSA)

N66-37340# General Electric Co., San Jose, Calif. Atomic Power Equipment Dept.
SPECIFIC ZIRCONIUM ALLOY DESIGN PROGRAM Quarterly Progress Report No. 9, Apr.–Jun. 1965
H. H. Klepfer, C. J. Baroch, R. E. Blood, J. L. Jaech, and E. A. Pickett Jul. 1965 55 p refs
(Contract AT(04-3)-189)
(GEAP-4840; EURAEC-1460) CFSTI: HC $3.00/MF $0.75

The Specific Zirconium Alloy Design Program was reinstated in November 1964 for the evaluation of a Zr+2.0 at. % Cr+0.16 at. % Fe alloy as nuclear fuel cladding. Tubing and bar stock of the alloy was obtained by fullscale vendor fabrication. Alloy-clad fuel rods were fabricated for irradiation in Consumer's Big Rock Reactor to a target exposure of 15,000 MWD/T. Technologically, there were no fabrication difficulties with the alloy. The fuel irradiation was delayed, however, by variable corrosion performance by this first vendor batch of alloy tubing and bar stock. Further tests on laboratory melts run side-by-side with the vendor samples confirmed the potential of the composition for excellent corrosion performance. The difference in performance between material from large, slow-cooling vendor ingots and small, fast-cooling laboratory melts was shown to be related to the size and uniformity of distribution of the intermetallic precipitates in the alloy. Material re-melted from the vendor forging and processed in the laboratory gave excellent performance; purposely slow-cooled laboratory samples gave poor performance in the same test. Experiments to determine the proper fabrication schedule for control of microstructure in full-scale processing are to be made. Another

experiment is in progress to establish the effect of nitrogen content in the range of 20 to 500 ppM on the corrosion rate of Zr+2.0 at. % Cr+0.16 at. % Fe in high-pressure, refreshed steam at 300, 400, and 500°C. Author (NSA)

N66-37406*# Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena.
REVIEW OF INDUSTRY-PROPOSED IN-PILE THERMIONIC SPACE REACTORS. VOLUME I: GENERAL
J. P. Davis, H. Gronroos, and W. Phillips 15 Oct. 1965 19 p refs
(Contract NAS7-100)
(NASA-CR-78331; JPL-TM-33-262, Vol. I) CFSTI: HC $1.00/MF $0.50 CSCL 18L

The present status of development and the problem areas associated with design are summarized. For a given fuel and at low power levels—less than 200 kw(e)—the externally fueled concept, by virtue of its high attainable fuel-volume fraction, results in smaller cores than the flashlight or single-diode internally fueled concepts. At higher power levels the differences are less pronounced. None of the potential nuclear fuels for thermionic reactors have yet demonstrated the burnup capability required for high-power, long-life systems. Author

N66-37512# European Space Vehicle Launcher Development Organization, Paris (France). Future Programmes and Advanced Studies Directorate.
ANALYSIS OF THE DEVELOPMENT PROSPECTS OF RADIO-ISOTOPIC SYSTEMS FOR SPACE USE
J. P. Contzen Jun. 1966 11 p Presented at the 11th Nucl. Congr., Rome, 23–25 Jun. 1966
(ELDO-TM-F-32) CFSTI: HC $1.00/MF $0.50

Describes the different types of radioactive isotope systems for three distinct types of space applications: spacecraft propulsion, production of on-board electrical energy, and heat or thermal radiation. Examines the conditions imposed by their development and analyzes the prospects for realization of operational systems from an European point of view. Author (ESRO)

N66-37531# Commissariat a l'Energie Atomique, Saclay (France).
THE CO_2 COOLING GAS FOR THE REACTORS G2/G3 (LEAKING, ANALYSIS, ACTIVITY) [LE CO_2 DE REFROIDISSEMENT DES REACTEURS G2/G3 FUITES, ANALYSE, ACTIVITE]
José Meiffren and Francis Dupay Oct. 1965 39 p refs In FRENCH
(CEA-R-2847) CFSTI: HC $3.00/MF $0.75

To improve the leakage problem and to reduce reactor operating costs, the classification of carbon dioxide circuits based on the kinematic property of the fluid around the core was determined. It is considered that this study contributed to a better understanding of fluid movements thereby providing orientation for leakage research projects. The less desirable elements found in CO_2 are considered: nitrogen, hydrogen, and methane. It was found more convenient to use CO_2 containing a very small volume of oxygen and argon. Under normal operating conditions, protection against irradiation was considered satisfactory. Removal of water from CO_2 in the circuit was found relatively easy. The G.2/G.3 reactors were equipped with a CO_2 control device for accurate measurements. Transl. by R.LI.

N66-37537# Technische Hogeschool, Eindhoven (Netherlands).
ON THE HYDRAULIC CHARACTERISTICS OF A BOILING WATER CHANNEL WITH NATURAL CIRCULATION
Cornelis Ludovicus Spigt 20 Jan. 1929 69 p refs CFSTI: HC $3.00/MF $0.75

Stability characteristics of a single coolant annular channel in a boiling water nuclear reactor were studied. Emphasis was placed on the liquid flow rate at the inlet and the void and pressure distribution along the height of the coolant channel, occurrence and characterization of spontaneous flow instabilities, and a steady state frequency response analysis. This analysis of boiling noise in terms of spectral power density and autocorrelation identified the onset of hydraulic instabilities with the help of an analog computer. Obtained results showed the influence of channel power, system pressure, subcooling, and hydraulic diameter on the recirculation flow rate, the exit void fraction, and the longitudinal void and pressure distribution. Preliminary calculations for the operating and geometric conditions discussed showed fairly good agreement with experimentally obtained quantities of the steady-state fluid performance, the instability threshold power, and the characteristics of the hydraulic oscillations. G.G.

N66-37549# United Kingdom Atomic Energy Authority, Risley (England).
AXIAL STABILITY CALCULATIONS FOR A.G.R. SYSTEMS
B. Wilson, J. R. Enselmoz, and A. J. Hartley 1966 73 p refs
(TRG-1138(R)) HMSO: 8s 6d

Three methods of calculating axial stability modes in reactor systems are described: (1) modal analysis, (2) a steady state method using 'FLIRT', and (3) an analog method. In the modal analysis, criteria for an asymmetric flux, flattened flux, and sinusoidal flux are derived with one-term and three-term expansion for the harmonic. The steady state method yields a criterion for temperature instability which can accommodate any flux distribution and more accurate harmonic representation. The analog method is used to study and propose a performance criterion based on the transient performance of the harmonic. Stability thresholds and the relationship between the performance criterion and stability margins are obtained. This latter method of calculation is recommended, and the major conclusions resulting from the study are shown. C.T.C.

N66-37554# United Kingdom Atomic Energy Authority, Risley (England).
THE STEAM-GENERATING HEAVY-WATER REACTOR
H. Cartwright 1966 16 p
(TRG-1246(R)) CFSTI: HC $1.00/MF $0.50

The main features of the steam-generating heavy-water reactor are described, particularly those leading to low cost with a high degree of safety. The prototype and extensive design studies have demonstrated the technical and economic attractiveness of the reactor. Its development potential is good, and it seems likely to be a competitor of other reactor systems at all sizes. Designs are available for immediate application from 100 MW(E), which would be a replica of the Winfrith prototype, to upwards of 300 MW(E), and larger sizes can be developed which may well compare favorably with present US and UK designs based on either water or gas coolant. The feasibility of a natural-uranium-fuelled SGHWR is discussed. Author

N66-37590# Atomic Energy of Canada, Ltd., Chalk River (Ontario).
AN IMPROVED SHEATHED ELECTRIC HEATER
J. A. Quarrington and G. A. Wikhammer Jul. 1966 19 p ref
(AECL-2592; PE-16) CFSTI: HC $1.00/MF $0.50

Heaters have been designed and built to give a surface heat flux in excess of 300 watts per square centimeter (ca. 1,000,000 BTU/sq.ft/hr). A high uniform thermal conductance is attained in two ways. Precision assembly techniques ensure concentricity between the heater spiral and the metal sheath with

minimum insulation thickness. High density boron nitride is used for electrical insulation; the high thermal conductivity of this material results in a relatively low heater spiral temperature. Methods of construction are described. Author

N66-37596# Societa Ricerche Impianti Nucleari, Saluggia (Italy). Centro Ricerche Nucleari.
THE 7-MW POOL REACTOR OF SORIN AS A RESEARCH AND IRRADIATION FACILITY
G. Casarelli et al 1965 105 p refs Presented at the IAEA Study Group on Irradiation Tech. at Res. Reactors, Istanbul, 15–19 Nov. 1965
(SORIN-76) CFSTI: HC $4.00/MF $0.75

A brief description of the reactor and of the modifications to bring the operating power from 2 to 7 MW is given, and details of the radiation characteristics are provided. A series of notes are included which illustrate the uses of the reactor radiation. These uses include structural determinations by neutron diffraction; shielding and reactor physics research at the thermal column; physical effects of irradiation at liquid nitrogen temperatures; ambient temperature irradiation of structural material, fissile material, and of organic liquids; and activation analysis and carrier free radioisotope production by non-thermal neutron spectra. H.S.W.

23 PHYSICS, GENERAL

Includes acoustics, cryogenics, mechanics, and optics. For astrophysics see: 30 Space Sciences. For geophysics and related information see also: 13 Geophysics; 20 Meteorology; and 29 Space Radiation.

N66-36498# Eidgenossische Technische Hochschule, Zurich (Switzerland).
EXPANSION OF A PHOTOELECTRIC-INTERFEROMETRIC METHOD TO MEASURE TEMPORARILY OSCILLATING PLANE TENSION STATES [ERWEITERUNG EINER PHOTOELEKTRISCH-INTERFEROMETRISCHEN METHODE AUF DIE MESSUNG ZEITLICH VERAENDERLICHER, EBENER SPANNUNGSZUSTAENDE]
Henri Haenggi (Ph.D. Thesis) 1965 91 p In GERMAN
(Rept.-3666) CFSTI: HC $3.00/MF $0.75

Dynamic stress phase changes in opaque rods were studied interferometrically by observing light intensity changes induced by the photoelastic stress wave oscillations in the models. Stress wave measurements of 200 μs on glass and aluminized rods clarified the influence of nonuniformities in the rod structures and the materials viscoelastic behavior during stress wave propagation. Transl. by G.G.

N66-36504# Comitato Nazionale per l'Energia Nucleare, Frascati (Italy).
COMPUTATION OF THE EFFECTS OF ERROS OF A MAGNETIC CHANNEL ON THE FINAL BEAM PARAMETERS
M. Bassetti and R. M. Buonanni 30 May 1966 34 p
(LNF-66/29) CFSTI: HC $2.00/MF $0.50

The correlation between the beam parameters at the output of a magnetic channel, the errors due to channel assembling, and errors induced by variations of current supply, is computed. Using the matrix method, the channel is first traced assuming magnetic elements without errors so as to obtain the theoretical values of prescribed variables. The channel is traced many times and a small but finite variation for the single element is introduced. Such variations were obtained by modifying computations for the element under consideration. The varied final parameters, together with the theoretical parameters, are used to compute the derivatives of the final parameters or incremental ratios. Speculation is made concerning the applicability of the method used to treat rigid displacements. S.C.W.

N66-36617# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
ABOUT APPROXIMATE REPRESENTATIONS OF THE ROUGHNESS OPERATOR
R. G. Barantsev and R. N. Miroshin *In its* Aerodyn. of Rarefied Gases, Collection I 21 Mar. 1966 p 194–206 refs (See N66-36606 22-12) CFSTI: HC $7.00/MF $1.75

The problem of a reasonable simplification of the roughness operator is considered from the viewpoint of possibly using known models in the various stages of solving the problem. The stages include: 1) the selection of a suitable random function with sufficiently concrete properties for describing a rough surface, 2) a study of the point process of overshoots of a random function above a broken line which is under consideration, and 3) the construction of a conditional probability of the absence of overshoots, i.e., the probability of flight II. Some of the most widely used approximation methods in the theory of random functions are examined for each of the three stages. They include: 1) the representation of the profile of a rough surface as an integral curve of a differential equation, 2) the approximation of the point process of overshoots, and 3) replacement of II by the probability of absence of overshoots at a finite number of points. R.N.A.

N66-36618# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
KINETIC EQUATION OF ADSORPTIVE LAYER
B. V. Filippov *In its* Aerodyn. of Rarefied Gases, Collection I 21 Mar. 1966 p 207–235 refs (See N66-36606 22-12) CFSTI: HC $7.00/MF $1.75

A system of kinetic equations is derived which describes a monomolecular gas with internal degrees of freedom in the presence of adsorption. R.N.A.

N66-36628# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
JOURNAL OF APPLIED MECHANICS AND TECHNICAL PHYSICS Collection of Articles
16 Feb. 1966 345 p refs Transl. into ENGLISH of Zh. Prik. Mekhan. i Techn. Fiz. (Moscow), no. 3, May–Jun. 1963 p 1–168
(FTD-MT-64-85; TT-66-61682; AD-635269) CFSTI: HC $7.00/MF $1.75

Articles on applied mechanics and technical physics are presented. For individual titles see N66-36629–N66-36661.

N66-36639# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
THEORY OF THE DEPOSITION OF A VISCOUS LIQUID ONTO A FIBER OF WIRE BEING WITHDRAWN FROM THE LIQUID
B. V. Deryagin *In its* J. of Appl. Mech. and Tech. Phys. 16 Feb. 1966 p 127–141 refs (See N66-36628 22-23) CFSTI: HC $7.00/MF $1.75

For application to the textile, glass fiber, electrical and synthetic fiber industries, formulas for determining the thickness of liquid film deposition on fibers are presented. A mathematical solution is reported on equations derived for the capillary and hydrodynamic phenomena taking place in the zone of meniscus and near the water line, which determine the capture of the liquid and thereby the thickness of the deposition. R.U.

N66-36659# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.

EXPERIMENTAL INVESTIGATION OF SPEED OF SOUND IN ARGON ON LINE OF SATURATION

I. S. Radovskiy *In its* J. of Appl. Mech. and Tech. Phys. 16 Feb. 1966 p 317–322 refs (See N66-36628 22-23) CFSTI: HC $7.00/MF $1.75

Tabular data are provided for systematic measurements of the speed of sound in vapor and liquid phases of argon on a curve of phase equilibrium at temperatures from 83.94°K to 150.65°K, i.e., from the triple point to the critical. It is seen that in a saturated vapor the speed of sound at 124.5°K passes through a maximum. With approximation to the critical temperature, the speed of sound sharply decreases, attaining a minimum value at the critical point. In a liquid phase, the speed of sound monotonically decreases from triple point to critical. It is also reported that the deceleration of sound intensified with increasing proximity to critical temperature, and that in the temperature interval from 103°K to 121.5°K, a linear dependence of the speed of sound in the liquid phase at a specified temperature is ascertained. R.Ll.

N66-36706*# Lockheed Missiles and Space Co., Sunnyvale, Calif.

LOW-TEMPERATURE EFFECTS ON MATERIALS FOR AEROSPACE MECHANISMS

Warren E. Henry *In* JPL 1st Aerospace Mech. Symp. [1966] 15 p refs (See N66-36691 22-31) CFSTI: HC $7.00/MF $2.00

The mechanical, thermal, electrical, and magnetic properties of materials at cryogenic temperatures are reviewed. Examples are given showing the relations between aerospace mechanisms' capabilities and performance with the physical properties of materials. The direct dependencies of the mechanisms behavior on temperature are outlined and illustrated. N.E.N.

N66-36809# Aeronautical Chart and Information Center, St. Louis, Mo. Linguistic Section.

A STATISTICAL ESTIMATE OF THE ACCURACY OF AVERAGING THE DISTURBED VALUE OF THE GRAVITATIONAL ACCELERATION FOR A FINITE PERIOD OF TIME [STATISTICHESKAYA OTSENKA TOCHNOSTI OSRED-NENIYA VOZMUSHCHENNOGO ZNACHENIYA SILY TYAZHESTI NA KONECHNOM OTREZKE VREMENI]

Yu. A. Tarakanov Jun. 1966 22 p refs Transl. into ENGLISH from Priklad. Geofiz. (Moscow), no. 37, 1963 p 135–146 (ACIC-TC-1066; TT-66-61776; AD-635573) CFSTI: HC $3.00/MF $0.50

Translation of Russian research: a statistical estimate of the accuracy of averaging the disturbed value of the gravitational acceleration for a finite period of time. TAB

N66-36954# Vanderbilt Univ., Nashville, Tenn.

FARADAY EFFECT AT HIGH MAGNETIC FIELDS

Robert Key Dismukes (M.A. Thesis) Jun. 1966 50 p refs (Contract AT(40-1)-1087) (TID-23030) CFSTI: HC $2.00/MF $0.50

Experiments were made to determine the extent of the region of measurement of Verdet constants and to investigate the possibility of nonlinearities at high magnetic fields, or of variations in the effect as a result of the field's time dependence. Monochromatic light from a laser was directed down the axis of a high field pulsed magnet and detected by a photomultiplier. This gave light intensity versus time data which were converted to a rotation versus field history for each run. NSA

N66-37068# Bausch and Lomb, Inc., Rochester, N. Y. Research and Development Div.

INFRARED COATING STUDIES Quarterly Report, 15 Dec. 1965–14 Mar. 1966

F. Sulzbach and A. F. Turner [1966] 33 p refs (Contract DA-44-009-AMC-124(T)) (QR-11; AD-635670) CFSTI: HC $2.00/MF $0.50

An experimental study was made of the reflectance of thick evaporated films in their reststrahlen (RST) regions of the infrared spectrum. Although only a few of the materials studied gave films having an efficient RST reflectance, many of them appeared optically acceptable for use as interference films. These may be clear without color and free of turbidity, i.e., designated therein as clear or only slightly scattering (sl. scatter.). They include films showing no cracks in optical thickness up to six microns or more, depending on substrate temperature of Al_2O_3, Nd_2O_3, CaF_3, SiO_2, Ti_2O_3, MgO, MgF_2, LiF, HfO_2 and ZrO_2. For RST reflectance purposes, e.g., reflection filtering, films of MgO were best, there being no difficulty in obtaining the full reflectance of the parent crystal. TAB

N66-37071# Applied Physics Lab., Johns Hopkins Univ. Silver Spring, Md.

ON THE DIFFRACTION OF PARTIALLY COHERENT LIGHT

B. A. Sotskii and A. M. Goncharenko 23 Jun. 1966 10 p refs Transl. into ENGLISH from Dokl. Akad. Nauk Belorussk. SSR, v. 8, no. 7, 1964 p 438–440 (Contract NOw-62-0604-c) (TG-230-T478; TT-66-61806; AD-635879) CFSTI: HC $1.00/MF $0.50

The diffraction of partially coherent light at a narrow slit is calculated for a given coherence function satisfying the wave equation at all points. It is shown that the divergence angle depends only on the wavelength and the coherence interval but not on the diameter of the end face. Since the divergence angle and coherence interval are uniquely related, and each can be obtained independently, a direct experimental check of the relation between the two is possible. Applicability of the results to describe the radiation from a dielectric resonator, e.g., a ruby laser, is discussed. Author (TAB)

N66-37081# Avco Corp., Lowell, Mass. Environmental Sciences and Technology Directorate

UNDERWATER ELECTRODELESS SPARK SOUND SOURCE Annual Technical Report

Hubert A. Wright, Jr. 20 Jul. 1966 69 p refs (Contract Nonr-4389(00)) (AVSSD-0008-66-CR, Rev. A; AD-636168) CFSTI: HC $3.00/MF $0.75

The electrodeless spark principle involves the generation of an underwater electric spark in the orifice of a dielectric barrier which separates two volumes of sea water. Research on impulse sound generation by such a principle is described which shows that the electrodeless spark discharge can be typified as: (1) extremely reproducible (2) capable of routine generation of peak pressures corresponding to 134 db/μ b at 1 yard (3) pulse lengths of 50μsec (4) extremely precise time of ignition (5) suitable for arrayed operation, i.e. no interaction between elements which are electrically paralleled (6) a potential to supress, and presumably to essentially eliminate, the secondary collapse, or bubble pulse (7) essentially omnidirectional except in some configuration. The dynamic equations of motion of a spherical bubble are discussed and aspects developed which are pertinent to the electrodeless spark dynamics. Parametric surveys of the electrodeless spark discharge are summarized, and device design and construction are described. Author (TAB)

N66-37083# Institute for Defense Analyses, Arlington, Va. Research and Engineering Support Div.

A WAVE FRONT RECONSTRUCTION PROCESS FOR A DISPLAY OF THE MULTIPLE BEAMS OF SEISMIC AND OTHER ARRAYS

W. Duane Montgomery Apr. 1966 32 p refs

(Contract ARPA SD-50)

(P-294; IDA/HQ-66-4822; AD-636142) CFSTI: HC $2.00/MF $0.50

The passive planar arrays used in receiving sonic waves through the earth or water, or those used in radio astronomy use mechanical or electronic scanning in order to observe a large solid angle such as 2π steradians. The purpose of the present paper is to develop a method for obtaining a real-time visual display of such wave fields. It is analogous to the use of a wide-angle lens for viewing large solid angles in the visible spectrum. The method uses a recently developed technique of incoherent holography as an analog, with the important difference that the sampling aspect of an array enables one to obviate any film processing stage. An appendix treats a few problems for seismic arrays. Author (TAB)

N66-37097# Toronto Univ. (Ontario). Inst. for Aerospace Studies.

A STUDY OF A NEON CYCLE CRYOGENIC PUMPING SYSTEM FOR A LOW DENSITY PLASMA TUNNEL

J. C. Lafrance Jul. 1966 134 p refs

(Contract Nonr-4073(00))

(UTIAS-116; AD-636149) CFSTI: HC $4.00/MF $1.00

This paper describes the development and testing of a large neon cycle cryogenic pump for use with a low density wind tunnel meant for both ionized and non-ionized flows. The development work necessary in the choice of the refrigerant cycle and the production of the required hardware is described in some detail. Once the cryogenic pump was in operation it was thoroughly tested both as a refrigerator system and as a pump. Experimental data on the thermodynamic properties of neon was obtained and found to be in excellent agreement with the available theoretical data. The refrigerator cycle was found to operate satisfactorily and as predicted. The pump itself was found to operate satisfactorily and as predicted over its entire designed range of operation. A pumping rate of 0.8 gr/sec N_2 was achieved while maintaining the test section pressure in the $1-4\times10^{-3}$ torr region. Author (TAB)

N66-37102# National Bureau of Standards, Boulder, Colo.

CALCULATION OF THE ADMITTANCE OF A PARALLEL PLATE CAPACITOR CONTAINING A TOROID-SHAPED SAMPLE

Eric G. Johnson, Jr. 21 Apr. 1966 42 p

(NBS-TN-336) GPO: $0.30

The theoretical admittance of a toroid-shaped sample in a parallel plate capacitor system is developed. This calculation represents a first and second order perturbation correction to the usual quasistatic formula. The Fortran listing of the machine program is included. The analysis is done under the condition that the sample is not in contact with the capacitor plates and can be described by a complex permeability, μ_m, and complex permittivity, ϵ_m. Author

N66-37104# Joint Publications Research Service, Washington, D. C.

DETERMINATION OF THE EXTINCTION COEFFICIENT IN SCATTERING MEDIA

A. P. Ivanov and A. Ya. Khayrullina 15 Sep. 1966 17 p refs Transl. into ENGLISH from Fiz. Atm. i Okeana (Moscow), v. 2, no. 7, 1966 p 721–728

(JPRS-37649; TT-66-34077) CFSTI: $1.00

Considered is the influence of scattering light on the effective value of the extinction coefficient as a function of the optical parameters of the medium and of the angle characteristics of the source and receiver. Tables of errors in the measured value of the extinction coefficient are prepared from which, given a certain accuracy of measurements, it is possible to make recommendations for the choice of measuring equipment under the corresponding conditions. Author

N66-37105# Joint Publications Research Service, Washington, D. C.

DETERMINATION OF THE PARTICLE SPECTRUM BY THE TRANSPARENCY METHOD FOR A LARGE PARTICLE CONCENTRATION

K. S. Shifrin, A. Ya. Perel'man, and V. G. Bakhtiyarov 15 Sep. 1966 12 p refs Transl. into ENGLISH from Fiz. Atm. i Okeana (Moscow), v. 2, no. 7, 1966 p 762–765

(JPRS-37652; TT-66-34080) CFSTI: $1.00

Plane models of sols—suspensions of small AgBr particles in gelatin—were investigated using the transparency method to determine the particle spectrum of a dispersion system. The regular optical density (optical thickness) of the layer of particles g(v) was determined for various wave numbers v. Seven models with different surface concentrations in a spectral interval $\lambda = 0.4-1.25$ mkm (micrometer) were examined. Equations are formulated for determining the particle spectrum from experimental values of g(v). It was concluded that in the sector of the spectrum under consideration, the relative coefficient of refraction of AgBr particles in gelatin is close to 1.5. Another important result of the experiments is proof of the possibility of using the transparency method for non-spherical particles. S.P.

N66-37197*# Army Missile Command, Huntsville, Ala.

PROFILE TYPES OF SOUND SPEED IN THE LOWER ATMOSPHERE AND THEIR RELATIONSHIPS TO ACOUSTIC FOCUSING

O. Essenwanger 15 Apr. 1966 36 p refs

(NASA Order H-61485)

(NASA-CR-78295; RR-TR-66-6; AD-635767) CFSTI: HC $2.00/MF $0.50 CSCL 20A

The derivation of characteristic profiles for the sound speed is discussed and a classification system introduced. The system comprises 32 types of sound profiles with subsequent division into three groups, namely without and with returning rays and with focusing. The idealized 32 prototypes of the classification system are based on the percentage reduction for orthogonal polynomials and the sound speed profiles are classified by utilization of the maximum relationship with the prototypes. The types show significant relationship with acoustic focusing and display practically no seasonal, azimuthal, or climatic variation for focusing. Therefore, seasonal, azimuthal, and climatic changes are caused by the occurrence of types. These seasonal, climatic, and azimuthal fluctuations of the types are presented. Author (TAB)

N66-37215*# Massachusetts Inst. of Tech., Cambridge. Research Lab. of Electronics.

[GENERAL PHYSICS, PLASMA DYNAMICS, AND COMMUNICATION SCIENCES AND ENGINEERING] Quarterly Progress Report No. 82

H. J. Zimmermann and George G. Harvey 15 Jul. 1966 312 p refs

(Grants NsG-496; NsG-334; NsG-419; NGR-22-009-091; Contract NSR-22-009-120)

(NASA-CR-78264) CFSTI: HC $7.00/MF $1.25 CSCL 20

Research activities of the Research Laboratory of Electronics during this period are reviewed. Research was conducted in the

areas of molecular beams, molecular collisions, microwave spectroscopy, radio astronomy, solid state microwave electronics, optical and infrared spectroscopy, noise in electron devices, physical electronics and surface physics, physical acoustics, electrodynamics of moving media, plasma physics, gaseous electronics, plasmas and controlled nuclear fusion, energy conversion, spontaneous radiofrequency emission from hot electron plasmas, interaction of laser radiation with plasmas and nonadiabatic motion of particles in magnetic fields, statistical communication theory, processing and transmission of information, linguistics, cognitive information processing, communications biophysics, psychoacoustics, neurophysiology, cardiovascular systems, and computation research. R.N.A.

N66-37233# University of Southern Calif., Los Angeles.
INFRARED SPECTRA OF MOLECULAR CRYSTALS Final Technical Report
David A. Dows, G. Andermann, L. Rubenstein, and N. Rich 31 May 1966 14 p refs
(Contract AF 49(638)-1308; Grant AF-AFOSR-62-165)
(AFOSR-66-1416; AD-635579) CFSTI: HC $1.00/MF $0.50

Studies were carried out to characterize and explain the infrared absorption and reflectance spectra of molecular crystals. Accurate methods of measuring reflectance spectra and of processing the data to obtain optical constants were developed and applied to sodium chlorate. Absolute infrared absorption intensities were measured for ethylenes, benzenes, acetylene and ethane. Theoretical studies of crystal splitting and lattice frequencies in benzene have provided data concerning intermolecular forces in this crystal splitting of ungerade vibrations, and provide the restoring force for torsional lattice motion. Phase changes in adamantane, cyclohexane and hexamethylbenzene were studied. Spectroscopically observable changes occurring at the phase transition temperature yield information concerning the molecular motions. Crystal spectra were used to aid in vibrational assignment of hydrazoic acid and cyclohexane. The unique properties of the crystal spectrum were of critical value in each case. Author

N66-37254# Rutgers Univ., New Brunswick, N. J. School of Chemistry.
MEASUREMENTS OF THE INFRARED SPECTRAL TRANSMITTANCE OF OPTICALLY THICK SAMPLES Technical Report, Dec. 1965–Jun. 1966
M. J. D. Low and L. Abrams 20 Jun. 1966 23 p refs
(Contract Nonr-404(19))
(TR-2; AD-636035) CFSTI: HC $1.00/MF $0.50

Continued improvements in instrumentation have led to a wide use of infrared transmission spectroscopy, and have permitted the examination of samples of limited transparency. However, although there is no particular problem with samples having about 2% transmittance or more, considerable difficulties arise if the transmittance is in the fractional percent range. The present paper is concerned with such energy-limited spectral measurements. The effects of self-emitted radiation, ordinate expansion, and scan time are considered. Author (TAB)

N66-37336# Gosudarstvennyi Komitet po Ispolzovaniyu Atomnoi Energii, Moscow (USSR). Institut Theoreticheskoi i Eksperimental'noi Fiziki.
SELECTION OF OPTIMUM CURVE OF RECTANGULAR LIGHT PIPES WITH NO LIGHT LOSSES BY REFLECTION [VYBOR NAILUCHSHEI FORMY IZGIBA PRYAMOUGOL'NYKH SVETOVODOV POLNOGO VNUTRENNEGO OTRAZHENIYA]
A. M. Blagorodov and I. A. Radkevich 1965 19 p refs In RUSSIAN; ENGLISH summary
(ITEF-385)

The form of the curve of the side edge of a curved light-pipe at which there are no light losses by reflection is calculated. Results of the absorption measurements in the light-pipe curved according to calculations have shown that the absorption is the same as in rectangular lightpipe of the same length. Author (NSA)

N66-37391# Avco Corp., Wilmington, Mass. Research and Technology Labs.
GEOMETRICAL ACOUSTICS' THEORY OF WAVES FROM A POINT SOURCE IN A TEMPERATURE-STRATIFIED AND WIND STRATIFIED ATMOSPHERE Scientific Report No. 5
Allan D. Pierce 2 Aug. 1966 38 p refs
(Contract AF 19(628)-3891)
(AVSSD-0135-66-CR; AFCRL-66-454; AD-636159) CFSTI: HC $2.00/MF $0.50

This paper is concerned with the propagation of acoustic waves in temperature- and wind-stratified atmospheres in the geometrical acoustics' approximation. The basic theory of Blokhintzev is shown to hold for propagation in the atmosphere, even when gravitational forces and pressure gradients are included, if wave periods are sufficiently short. The 'ray-tracing' equations are derived from the Eikonal approximation using Cauchy's method of characteristics, and the boundary conditions on these equations appropriate to a point source are discussed. Previous approximate methods of integrating the ray-tracing equations with the neglect of cross-winds are discussed, and a formulation due to Lee is corrected. A numerical method is introduced which allows cross-winds to be taken into account. An extension of this method, to include earth curvature effects, is also included. Author (TAB)

N66-37515*# Bolt, Beranek, and Newman, Inc., Cambridge, Mass.
ROCKET NOISE
J. E. Efowcs Williams and G. Maidanik 21 Oct. 1965 62 p refs *Its* Rept.-1324
(Contract NAS1-4497)
(NASA-CR-66165) CFSTI: HC $2.50/MF $0.75 CSCL 20A

In considering the aerodynamic sound radiated by turbulent flow at high Mach number, an exploratory analysis was conducted to decipher the relationship between parameters of the turbulence field and its generated radiation field. The analysis is based on Lighthill's formula for the radiation field generated by free turbulent flow. Based on this formula, the cross-correlation of the radiation field is constructed, and the stationary phase method is used to reduce some of the integration involved. A far field theory of sound generation by sources in inhomogeneous convective motion is described. The argument favoring a general convective wave equation as a basis for aerodynamic noise theory is qualitatively described. A generalized theory of convective sources is examined, including alternative descriptions of the radiation field, radiation from convective sources, nonsingular Lienard–Wiechert potential, and the field of convected multipoles. N.A.S.

N66-37555# Toegepast Natuurwetenschappelijk Onderzoek, Rijswijk (Netherlands).
CONCENTRATING DILUTE AEROSOLS BY ELECTROSTATIC METHODS
J. F. van der Wal Jun. 1966 22 p refs
(TDCK-45747) CFSTI: HC $1.00/MF $0.50

A first attempt was made to develop a method by which aerosols can be concentrated, using electrostatic principles. Plastics were given an electrostatic charge by sudden removal of the plastic from a high voltage source. The aerosol was precipitated on the charged plastic. The concentration of the

precipitated aerosol was determined with an electron-microscope. The reproducibility of this tentative method is reasonably good, compared with methods based on other electrostatic phenomena. In the present stage, the method is insufficiently sensitive; this might be improved by optimization of the experimental conditions. Author

N66-37577*# Michigan Univ., Ann Arbor. Radiation Lab.
TOPICS IN ELECTRODYNAMICS OF MOVING MEDIA Final Report, 1 May 1965-1 May 1966
C. T. Tai, V. Pyati, and R. M. Kalafus May 1966 25 p refs
Its Rept.-7322-1-F
(Grant NGR-23-005-107)
(NASA-CR-78393) CFSTI: HC $1.00/MF $0.50 CSCL 20C

A technical outline of works concerned with the electrodynamics of moving media which have not yet appeared in a technical report or been submitted for publication is given. They include a detailed study of the problem of a small antenna over a moving dielectric media, and a paper concerning the present views on the theory of electrodynamics of moving media. Some of the complexities introduced into the theory by extending it to conducting media are discussed. Several applications are presented which involve the Cerenkov radiation effect. An earlier work on a drifting magneto-ionic plasma is extended to finding the characteristic indices of refraction for some configurations of plasma parameters. The final section deals with the formulation of the time-dependent Green's function for moving lossless media. R.N.A.

N66-37582*# Rochester Univ., N. Y. Inst. of Optics.
PROPERTIES OF MULTILAYER FILTERS Interim Report, Mar. 1-Aug. 31, 1966
P. W. Baumeister [1966] 26 p
(Grant NsG-308-63)
(NASA-CR-78341) CFSTI: HC $2.00/MF $0.50 CSCL 20F

A multilayer band-pass filter of the design: air (dielectric stack) M (spacer) M (dielectric stack) Q has been fabricated and has a maximum transmittance of 0.67 and full width at 0.5 T_{max} of 84Å. In this design, M represents an aluminum layer of 150Å thickness and the dielectric spacer is cryolite. The possibility of using interference effects in thin films of indium, gold, and aluminum to produce filters in the spectral region below 1200Å is investigated. From calculations based upon the published values of the optical constants of these materials, it is concluded that such filters are not feasible and would have poor rejection properties. Author

24 PHYSICS, ATOMIC, MOLECULAR, AND NUCLEAR

Includes atomic, molecular, and nuclear physics. For applications see: 22 Nuclear Engineering. For related information see also: 29 Space Radiation.

N66-36457# European Organization for Nuclear Research, Geneva (Switzerland).
LAYOUT OF THE NEW CERN NEUTRINO BEAM
A. Asner and Ch. Iselin 4 Jul. 1966 30 p ref
(CERN-66-24)

Details are given on the length of decay path of the neutrino beam, and different possible versions with their parameters and their corresponding neutrino and antineutrino fluxes are illustrated by tables and graphs. It is shown which parameter values will give the optimum spectra with respect to different points of view. Horn shape, shielding length, momentum of primary protons, current in the focusing devices, target shape, and ν_e spectrum are discussed. L.E.W.

N66-36563# Comitato Nazionale der I Energia Nucleare, Frascati (Italy). Laboratori Nazionali di Frascati.
CHARGED PION PHOTOPRODUCTION ON LIGHT NUCLEI
S. Ferroni, V. Gracco, P. Lehmann, B. Merkel, and C. Schaerf 6 Jun. 1966 13 p refs *Its* Nota Interna No. 324
(LNF-66/30) CFSTI: HC $1.00/MF $0.50

The differential cross section for the photoproduction of charged pions on light nuclei has been measured for different values of the photon energy using the excitation curve method. Hydrogen, Lithium 6, Lithium 7 and Carbon have been studied. We found no correlation with the detailed structure of the final nuclei. The data seem consistent with a model where the nucleons are considered as independent emission centers and where reabsorption from the other nucleons in the nucleus is taken into account. This appears to be valid both for single and double pion photoproduction. Author

N66-36603# Laboratoire De Physique Theorique et des Hautes Energies, Orsay (France).
THREE PARTICLE STATES AND GREEN'S FUNCTIONS
J. Y. Pasquier Jul. 1966 28 p refs
(TH-162) CFSTI: HC $2.00/MF $0.50

The six-dimensional spherical harmonics are specified in connection with SO_6 and particular subgroup, isomorphic to SO_3 and SO_2. Three-particle states are then labelled by the grand-angular momentum n, the usual angular momentum j, its projection on a fixed axis m, an integer μ related to SO_2, and a degeneracy number ω. Also, we derive the plane-wave and free Green's function expansions in terms of these spherical harmonics. Author

N66-36604# Laboratoire de Physique Theorique et des Hautes Energies, Orsay (France).
TOWARD A NEW THEORY OF SPHERICAL NUCLEI, I
G. Do Dang and A. Klein (Penn. Univ.) Jul. 1966 30 p refs Sponsored in Part by AEC
(TH-159) CFSTI: HC $2.00/MF $0.50

A tentative theory of the quadrupole moment (Q_{2+}) of the first 2+ excited state of spherical nuclei is developed as a logical extension of the methods used in the usual theory based on pairing plus quadrupole–quadrupole interaction. In the latter in which the quasi particle occupation amplitudes in the ground state are taken to be of zero order and the off-diagonal amplitudes connecting the ground state with the 2+state to be of first order (and described by random phase approximation), Q_{2+} is nominally of second order. We find that in a consistent calculation, the quadrupple deformation is driven by the off-diagonal amplitudes, but that there is also the possibility of a self-sustained deformation for sufficiently large quadrupole coupling constants. Numerically, one finds ranges of the latter, all in accord with the excitation energy and the E2 transition probability, for which Q_{2+} shows extremely rapid variations, and in particular, also assumes values sufficiently large, as to contradict the whole basis of the calculation. The need for a self-consistent intermediate coupling calculation is indicated. Author

N66-36626# Atomic Energy of Canada, Ltd., Chalk River (Ontario).
PHYSICS DIVISION Progress Report, 1 Jul.-30 Sep. 1965
L. G. Elliott, G. C. Hanna, H. Carmichael, G. A. Bartholomew, and H. H. Clayton [1965] 68 p refs
(AECL-2595; PR-P-67) CFSTI: HC $3.00/MF $0.75

Various developments in nuclear physics research, solid state studies, and computer programming are reported. Nuclear physics work included improvement of a recoil method for measuring nuclear lifetime, in which a 25 cm^3 Li drifted Ge gamma-ray detector is used. The angular correlation technique involving the high resolution magnetic particle spectrometer and four NaI(Tl) gamma-ray detectors was used to extend measurements on the reaction $12C(^{16}O, \alpha\ \gamma)^{24}Mg$. A magnetic beta-ray spectrometer was used in studying the internal conversion electrons from gamma-ray transitions produced in nuclear reactions. In solid state studies, the inelastic scattering of neutrons from cobalt oxide was investigated with a triple axis crystal spectrometer at the C5 beam facility at 90°K and 430°K. The low lying frequency vs. wave-vector dispersion curves for lattice vibrations propagating along the c axis of α quartz at 296°K were measured using a triple axis neutron spectrometer. Developments in computer programming include the writing of programs for calculating the effects of space and image charges in a bunched beam of charged particles, for the evaluation of integrals of varying functions, and for neutron calculations. K.W.

N66-36632# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.

INVARIANT GROUP SOLUTIONS OF EQUATIONS OF A SPATIAL STATIONARY BEAM OF CHARGED PARTICLES

V. A. Syrovoy *In its* J. of Appl. Mech. and Tech. Phys. 16 Feb. 1966 p 44-63 refs (See N66-36628 22-23) CFSTI: HC $7.00/MF $1.75

Group properties were investigated for equations of a stationary normal beam of analogously charged particles in an arbitrarily oriented external magnetic field, both for relativistic and nonrelativistic velocities. A common solution was found for a system of determining equations for coordinates of infinitesimal operators, determining a basic group of G equations of the beam (S). The invariant-group solutions were obtained in four orthogonal systems of coordinates: Cartesian x, y, z; cylindrical R, ψ, z; spiral cylindrical q_1, q_2, z; spherical r, θ, ψ. It is stated that the Cartesian and cylindrical system of coordinates are limiting cases of spiral cylindrical system of coordinates. It was concluded that from all enumerated solutions of equations of a relativistic beam, only the solution for single-component flow in z-direction is not invariant with all the functions f. R.Ll.

N66-36684# Comitato Nazionale per L'Energia Nucleare, Frascati (Italy). Laboratori Nazionali di Frascati.

EFFECTS OF A LONGITUDINAL MAGNETIC FIELD ON PROPERTIES OF RAYS IN ADONE [EFFETTI DI UN CAMPO MAGNETICO LONGITUDINALE SULLE PROPRIETA' DEI FASCI IN ADONE]

A. Tenore 10 May 1966 22 p refs In ITALIAN *Its* Nota Interna no. 321
(LNF-66/25) CFSTI: HC $1.00/MF $0.50

To analyze the reaction particles produced in some Adone experiments, it is necessary to make use of the magnetic field along the beam path. Investigated are the effects of a longitudinal magnetic field, and the restrictions on the intensity of the Adone beam. Mathematical calculations include equations derived for the solution of a closed-circuit linear equation; a charged particle in a uniformly axial magnetic field, constant in time; the fringing matrix approximation; and, the matrix presenting the total effect of the magnetic field. Angular crossing, and particle beam bunches are also mentioned. Experimental data indicate that with angular crossing, the intensity of the magnetic field is very slight, and two methods are presented for compensating the magnetic field on the beam. Transl. by R.Ll.

N66-36685# Polish Academy of Sciences, Warsaw. Inst. of Nuclear Research.

EFFECT OF DELAYED NEUTRONS ON THE SPECTRUM OF THE TRANSPORT OPERATOR

Janusz Mika Mar. 1966 29 p refs
(Contract IAEA-398/RB)
(INR-700/XXI/RP) CFSTI: HC $2.00/MF $0.50

The effect of delayed neutrons on the spectrum of time-eigenvalues of the transport operator is considered. These results are compared with those obtained in the diffusion approximation. Author

N66-36719# Laboratoire de Physique Theorique et des Hautes Energies, Orsay (France).

PROTON RECOIL CORRECTIONS TO THE HYPERFINE SPLITTING OF THE HYDROGEN ATOM

F. Guerin Jul. 1966 53 p refs
(TH/164) CFSTI: HC $3.00/MF $0.50

A very simple method is presented for the calculation of the corrections that depend on the proton mass in the hyperfine splitting of the hydrogen atom, for the case of a point proton. The calculation is straightforward, but the proof is rather long and involves the use of the Bethe–Salpeter equation. The low-energy theorem for Compton scattering is generalized to the case of virtual photons, in order to prove rigorously that the corrections arising from the structure of the proton will not involve the electron mass, and will depend only on the spin-dependent part of the forward photon-proton scattering amplitude. A breakdown of quantum electrodynamics which assumes a modified photon propagator or a modified photon-electron vertex cannot remove the discrepancy between theory and experiment. Author

N66-36756# Comitato Nazionale Per L Energia Nucleare, Frascati (Italy). Laboratori Nazionali di Frascati.

A MEASUREMENT OF THE BRANCHING RATIO $\omega \rightarrow$ NEUTRALS/$\omega \rightarrow \pi^+ + \pi^- + \pi^\circ$

G. Di Giugno, I Peruzzi (Naples Univ.), M. Giorgi, P. Schiavon (Trieste Univ.) V. Silvestrini et al 21 Jun. 1966 10 p refs *Its* Nota Interna No. 325 Submitted for Publication
(LNF-66/31) CFSTI: HC $1.00/MF $0.50

Branching ratio of nonleptonic resonance decay measured at CERN by a counter technique was found to be $\omega \rightarrow$neutrals/$\omega \rightarrow \pi^+ + \pi^- + \pi^\circ = (13.4 \pm 2.6)\%$ as compared to the world average is given as $(10.6 \pm 1)\%^+$. Including the new finding, the world average is estimated to be $(10.8 \pm 0.9)\%$. The experimental layout is illustrated, and graphs depict neutron time of flight spectra. M.W.R.

N66-36757# Polish Academy of Sciences, Cracow. Inst. of Nuclear Physics.

MAGNETIC PROPERTIES OF STRONGLY DEFORMED NUCLEI [MAGNITNYE SVOISTVA SILBNO DEFORMIROVANNYKH ATOMNYKH YADER]

Andrei Khrynkevich and Stanislav Ogaea May 1966 49 p refs In RUSSIAN; ENGLISH summary
(REPT.-466/PL) CFSTI: HC $2.00/MF $0.50

A basic description of magnetic properties of nuclear states is presented. The phenomenological treatment of magnetic properties of deformed nuclei is followed by the discussion of the influence of residual nucleon–nucleon interactions on static and dynamic nuclear magnetic moments. The long-range spin–spin interaction inducting a spin polarization of the nuclear core and the short-range pairing correlations are taken into account. The experimental methods for the determination of magnetic moments of ground excited nuclear states and the reduced transition probabilities for MI-transitions are discussed. The good agreement between the theoretical and experimental determined values of g_K-and g_R-factors shows that the present theoretical description of the magnetic properties of deformed nuclei is quite statisfactory. Author

N66-36791# Soreq Research Establishment, Israel Atomic Energy Commission, Yavneh.

THE OPERATOR FOR SPIN FORBIDDEN TRANSITIONS Scientific Report No. 2

Robert Englman Dec. 1965 14 p refs
(Contract AF 61(052)-806)
(AFCRL-66-386; AD-635830) CFSTI: HC $1.00/MF $0.50

It is shown that the use of the dipole moment operator to calculate probabilities of transitions with change of spin gives results in many cases correct to within 1 to 1/100 of a percent. The matrix element of the operator is between the large components of spinors. Author (TAB)

N66-36884# Illinois Univ., Urbana. Dept. of Physics.

ROLE OF MESON CURRENT IN THE DETERMINATION OF NEUTRON FORM FACTORS FROM ELASTIC ELECTRON-DEUTERON SCATTERING

Klaus Dietz and Melvin Month [1966] 9 p refs
(Contract Nonr-1834(05))
(AD-635916) CFSTI: HC $1.00/MF $0.50

Information on the electro-magnetic (e-m) neutron form factors is mainly deduced by inference from electron–deuteron scattering. Consideration is given to the use of elastic-scattering data; and results are compared with those of DeVries et al. (Phys. Rev. v134 pb848 1964) who obtained their results by using only inelastic electron–deuteron scattering data. TAB

N66-36896# Massachusetts Inst. of Tech., Cambridge. Fluid Mechanics Lab.

THEORY OF THE LINEAR FOKKER–PLANCK COLLISION OPERATOR

C. H. Su May 1966 28 p refs
(Contract Nonr-1841(93))
(Publ.-66-4; AD-635570) CFSTI: HC $2.00/MF $0.50

The linearized Fokker–Planck collision integral with coulomb interaction is expanded in terms of surface spherical harmonics. The radial part of the distribution function is shown to be governed by a set of decoupled differential-integral equations. The differential operators are shown to be self-adjoint while the integral operators are summetry and completely continuous. The spectrum of the eigenvalues contains, on top of discrete points, a continuous part ranging from zero to minus infinity. The discrete part of the spectrum is obtained by requiring that the corresponding eigenvectors have a definite asymptotic behavior at large velocity. A variation principle is constructed for the computation of the discrete spectrum. Author (TAB)

N66-36936# Naval Air Engineering Center, Philadelphia, Pa. Aeronautical Materials Lab.

NEUTRON ACTIVATION ANALYSIS Progress Report

A. L. Glass and Edwin S. Tankins 24 May 1966 10 p refs
(PR-1; AD-635692) CFSTI: HC $1.00/MF $0.50

The object of the initial phase of the investigation was to obtain and install a system with adequate shielding for neutron activation analysis and to provide the additional laboratory facilities for its use. A description of the equipment obtained, with the shielding that was erected is given. Author (TAB)

N66-36943# Illinois Univ., Urbana. Dept. of Physics.

THE N* IN DEUTERON REACTIONS AS A LANDAU SINGULARITY

Melvin Month [1966] 11 p refs
(Contract Nonr-1834(05))
(AD-635915) CFSTI: HC $1.00/MF $0.50

Recently, some attempts have been made to describe what is termed the N effect in various deuteron reactions, using field theoretical (perturbation theory) methods. Previously, the N peaks were introduced in a phenomenological way—i.e., as final state interactions. It is pointed out, in a qualitative way that a possible fallacy exists in the new approach (and in the phenomenological methods as well), and an alternative mechanism for producing the N effect is suggested. TAB

N66-36950# IIT Research Inst., Chicago, Ill. Technology Center.

EFFECT OF HIGH SPIN ON ELECTROMAGNETIC DECAY OF NUCLEI Third Annual Report

Daniel Sperber 9 Jun. 1966 24 p
(Contract AT(11-1)-578)
(IITRI-578P25-15) CFSTI: HC $1.00/MF $0.50

A new method was developed for calculating isomeric cross sections. The method is very general and does not depend on the spin value of the compound nucleus. It can be applied equally well both to heavy-ion reactions, in which the compound nucleus has a high spin value, and to (n,γ) reactions, in which the compound nucleus has a low spin value. A method based on the collective model was developed for calculating angular distribution. The method enables evaluation of the angular distribution due to transitions between high spin states in highly deformed nuclei. A method was developed for calculating effects of competition between M1 and E2 transitions involving high spin states. The method showed that this competition influences the angular distribution of gamma rays from high spin states and that the energy dependence of the angular distribution is due to this competition. Parametric studies showed that comparison between the described theory and experiment allows determination of the multipolarity of radiation between high spin states and better determination of the nuclear density of levels. Combination of all the above information leads to more complete understanding of the approximate model for high spin states. Author (NSA)

N66-36952# California Univ., Berkeley. Lawrence Radiation Lab.

PROTON-PROTON ELASTIC SCATTERING AT INCIDENCE MOMENTA 3, 5, AND 7 Bev/C

Allan Roy Clyde (Ph.D. Thesis) May 1966 110 p refs
(Contract W-7405-ENG-48)
(UCRL-16275) CFSTI: HC $4.00/MF $0.75

Differential cross sections for p-p elastic scattering were measured for incident momenta, 3, 5, and 7 Bev/c. The backward scattered protons were momentum analyzed with magnetic spectrometers and detected with scintillation counters for the missing mass spectrum of $p + p \rightarrow p + x$ for x = a proton. A hydrogen gas target was used for recoil momenta from 75 to 600 Mev/c and polyethylene with matched carbon for subtraction was used from 500 to 4000 Mev/c. Statistical errors were approximately 2% at low momentum transfer, and increased to about 5% for 90° scattering in the center-of-mass. The data indicates shrinkage of the diffraction peak with incident energy, a strong energy dependence of $d\sigma/d|t|$ at 90° and is consistent with a logarithmic decrease in the total elastic cross section with the center-of-mass energy. The behavior of the forward scattering indicates the presence of a real scattering amplitude. The values obtained for the ratio of the real to the imaginary scattering amplitudes are 43, 39, and 34% respectively. An assumption of similar angular dependence of the real and imaginary parts of the nucleon scattering amplitude is indicated by these data. Author (NSA)

N66-36953# California Univ., Berkeley. Lawrence Radiation Lab.

PROPERTIES OF THE NEUTRAL CASCADE HYPERON

John Richard Hubbard (Ph.D. Thesis) 25 Apr. 1966 59 p refs
(Contract W-7405-ENG-48)
(UCRL-11510) CFSTI: HC $3.00/MF $0.75

The production of neutral cascade hyperons by incident K^- on hydrogen was studied from threshold at 1.05 Bev/c to 1.7 Bev/c. A sample of 206 Ξ^0 events was obtained. Production cross sections rise to about 120 μb for Ξ^0K^0, 25 μb for $\Xi^0K^0\pi^0$, and 50 μb for $\Xi^0K^-\pi^-$ at 1.7 Bev/c. The mean life is $\tau_{\Xi^0} = 2.53^{+0.28}_{-0.23} \times 10^{-10}$ sec. The decay asymmetry is $\alpha_{\Xi^0} = -0.20$

± 0.22. The branching ratios are less than 1% for $\Xi^0 \rightarrow \Sigma^{\pm} 1^{\pm} \nu$, and $\Xi^0 \rightarrow p 1^- \nu$, and $\Xi^0 \rightarrow p\pi^-$, where $1^{\pm}$ signifies $e^{\pm}$ or $\mu^{\pm}$.
Author (NSA)

N66-36959# Kansas Univ., Lawrence. Nuclear Physics Lab.
SPIN ASSIGNMENTS FROM TRIPLE CORRELATION UTILIZING AXIAL SYMMETRY
F. W. Prosser, Jr. [1966] 44 p ref From Intern. Symp. on the Structure of Low-Medium Mass Nuclei, Wright-Patterson AFB, Ohio
(Contract AT(11-1)-1120)
(COO-1120-43; CONF-660417-1) CFSTI: HC $2.00/MF $0.50

An analysis of the following situation is presented. Consider an initial gamma emitting state of interest a_0 which is prepared by bombardment of an unpolarized target with an incident, unpolarized radiation L_1, whose direction is the z-axis, and the subsequent emission of a radiation L_2. The only property of L_2 of immediate interest is that its detection be such as to preserve the axial symmetry of the system. The general angular correlation is given in terms of the statistical and efficiency tensors of state a_0. However, the conditions of axial symmetry, unpolarized target and beam, and sharp spin and parity for a_0 cause the density matrix to be diagonal with equal values for positive and negative substrates. Several examples are described. (NSA)

N66-36960# Atomic Energy of Canada, Ltd., Chalk River (Ontario).
METHODS OF APPLYING COMPTON SCATTERED NEUTRON CAPTURE RADIATION TO NUCLEAR PHOTO-EXCITATION
J. W. Knowles and N. M. Ahmed 14 Mar. 1966 90 p refs
(AECL-2535) Available from Atomic Energy of Canada, Ltd., Chalk River: $3.00

Two facilities are described which use Compton scattered (n,γ) radiation as a source of radiation of continuous energy distribution suitable for nuclear photo-excitation experiments. In the first facility, thermal neutrons are captured in a thin plate of cadmium and the subsequent (n,γ) radiation is scattered from surrounding graphite. The intensity of the scattered radiation incident on the target, 10 meters from the source, is ~ 1 quantum $ev^{-1}cm^{-2}sec^{-1}$ and includes all energies from 0.1 to 8.0 Mev. In the second facility, neutrons are captured in a composite plate of titanium and nickel. Characteristic radiations from this source, the 1.37- and 6.75-Mev γ-rays of ^{49}Ti and 8.99-Mev γ-ray of ^{59}Ni, are Compton scattered from a curved aluminum plate. The relative positions of source, scatterer and target are such that scattered radiation of one energy converges to a line at the target position. The energy of the incident radiation is varied by moving the target to a different angular position with respect to the scatterer. The energy range is 0.5 to 8.5 Mev and the energy selection is 1 – 3%. The intensity of γ-radiation, of 7 Mev, incident on the target is ~ 1 quantum $ev^{-1}cm^{-2}sec^{-1}$. Radiation from a target, scattered between 90° and 135°, is detected by NaI (Tl) scintillators. Using the first facility, nuclear resonance scattering of γ-radiation was observed, between 0.8 and 6 Mev, from targets of LiF, Au and Al. Using the second facility, scattering and self-absorption measurements were made, between 5.5 and 8.0 Mev, on targets of natural and radio-lead. Author (NSA)

N66-36961# Commissariat A L'Energie Atomique, Saclay (France). Centre D'Etudes Nucleaires.
STUDY OF THE $^{51}V(p,n)^{51}Cr$ REACTION AND CONTRIBUTION TO THE SPECTROSCOPY OF ^{51}Cr [ETUDE DE LA REACTION $^{51}V(p,n)^{51}Cr$ ET CONTRIBUTION A LA SPECTROSCOPIE DE ^{51}Cr]
Yves Cassagnou (Ph.D. Thesis–Paris Univ., France) 1966 82 p refs In FRENCH; ENGLISH summary
(CEA-R-2832)

Neutrons and gamma rays from the reaction $^{51}V(p,n)^{51}Cr$ were studied between 2.3 and 5.1-Mev. Energy levels of ^{51}Cr at 0.75, 1.15, 1.35, 1.47 and 1.56 Mev and unresolved levels at 1.94, 2.4, 2.75 and 2.9 Mev are observed. The gamma ray cascades of the low-lying states of ^{51}Cr up to 2.5-Mev excitation energy were completely determined through coincidence measurements. From the cascade ratios and gamma ray yields, excitation functions for the $^{51}V(p,n)^{51}Cr$ reactions, leading to the five lowest levels of ^{51}Cr were obtained from reaction threshold to 4.6 Mev. The analysis of cross section fluctuations with good resolution shows they are due to the excitation of unresolved compound nucleus isolated resonances. From the decay scheme and an Hauser–Feshbach calculation of the $^{51}V(p,n)$ excitation functions, spin assignments of 3/2–, or 5/2–(0.75 Mev), 7/2–(1.15 Mev), 3/2–(1.35 Mev), 5/2–1.47 Mev) are proposed. Author (NSA)

N66-36962# Atomics International, Canoga Park, Calif.
APPLICATION OF THE P_3 METHOD TO THE CALCULATION OF PARTICLE FLUXES IN SHIELDS
W. B. Green 17 Mar. 1966 17 p refs
(Contract AT(11-1)-GEN-8)
(NAA-SR-Memo-11872) CFSTI: HC $1.00/MF $0.50

The P_L method for solving the Boltzmann Transport Equation is described and the derivation of the P_3 equations for a one dimensional, source-free, semi-infinite slab medium is summarized. Appropriate boundary conditions for use in a multiregion shield, with a source at the left face and a vacuum at the right face, are introduced. The solutions to the P_3 equations are shown to be analytic within each energy group and a method is outlined in detail for solving the general multigroup problem. The method is applicable to problems in both neutron and gamma ray transport.
Author (NSA)

N66-36963# Oak Ridge National Lab., Tenn.
FORTRAN LISTINGS AND FLOW CHARTS FOR ZAP31: A PROGRAM TO CALCULATE B-Γ RADIATION DOSE RATES FROM A SPHERICAL OR SLAB SOURCE
23 May 1966 61 p refs
(Contract W-7405-ENG-26)
(ORNL-TM-1160) CFSTI: HC $3.00/MF $0.75

A FORTRAN-63 and CODAP2 program, ZAP31 was written for the CDC 1604A computer for the calculation of β-γ radiation depth dose in matter from spherical or slab sources. Listings and flow charts for the ZAP31 program are given. Author (NSA)

N66-36964# California Univ., Berkeley. Lawrence Radiation Lab.
THE REACTION K^-p YIELDS Λ-Ω FROM 1.2 TO 2.7 BEV/C: THE ABSORPTION MODEL WITH STRANGE-MESON EXCHANGE
Stanley Martin Flatte (Ph.D. Thesis) 9 Mar. 1966 81 p refs
(Contract W-7405-ENG-48)
(UCRL-16648) CFSTI: HC $3.00/MF $0.75

Over 9000 $K^-p \rightarrow \Lambda\omega \rightarrow (p\pi^-)(\pi^+\pi^-\pi^0)$ events were analyzed in four momentum regions between 1.2 to 2.7 Bev/c. The differential cross section and the eleven independent decay-correlation parameters were determined as a function of production angle for each of the four momentum regions. A striking forward peak in the differential cross section at our highest momentum, 2.6 Bev/c, suggests the appearance of strange-meson exchange. Using a new formalism for the absorption model it is shown that the behavior of the differential cross section and the decay-correlation parameters at 2.6 Bev/c as a function of production angle is qualitatively explained by the absorption model with K and K* exchange, using available data on $K^-p \rightarrow \Lambda\phi$, and that the comparison between the couplings of $K^-p \rightarrow \Lambda\omega$ and $K^-p \rightarrow \Lambda\phi$ is in reasonable agreement with SU(3) predictions. Author (NSA)

N66-36966# California Univ., Berkeley. Lawrence Radiation Lab.
LEPTONIC DECAYS OF NEUTRAL K MESONS
Robert Leon Golden (Ph.D. Thesis) 28 Mar. 1966 52 p refs
(Contract W-7405-ENG-48)
(UCRL-16771) CFSTI: HC $3.00/MF $0.50

In the Alvarez 72-inch hydrogen bubble chamber, neutral K mesons are obtained from 6544 reactions of the type $\pi^- p \rightarrow \Lambda K^0$, with a visible Λ decay, $\Lambda \rightarrow p\pi^-$ (the beam was operated at π^- momenta of 1035 and 1170 Mev/c). A sample of 54 neutral K decays of the types $K \rightarrow \pi^\pm e^\pm \nu$, $\pi^\pm \mu^\pm \nu$ is examined to test the $\Delta I = 1/2$ and $\Delta S = \Delta Q$ selection rules. An analysis of about one third of the 54-event sample was previously published by Alexander et al. The long-lived K_L leptonic decay rate was measured and found to be $\Gamma_L = (11.3 \pm 1.9) \times 10^6$/sec. This differs by 0.6 standard deviation from the $\Delta I = 1/2$ prediction $\Gamma_L = 2[\Gamma(K^+_{e3}) + \Gamma(K^+_{\mu 3})] = (12.4 \pm 0.7) \times 10^6$/sec. 31 events were used for which the lepton charge is known to construct a likelihood function based on the T-invariant time distribution $1 + \gamma \exp(-\lambda_s t) + 2q\alpha \cos \Delta m t \exp(-\lambda_s t/2)$, where $q = +1$ if the decay involves a positive lepton and $q = -1$, if the decay involves a negative lepton. Using $\Delta m = 0.75 \times 10^{10}$/sec, one measures $\gamma = 1.4^{+1.4}_{-0.5}$, $\alpha = 1.0^{+0.3}_{-0.5}$, consistent with the $\Delta S = +\Delta Q$ predictions $\gamma = 1.0$, $\alpha = 1.0$. An analysis is presented of the time distribution of all 54 events. The time distribution used was $1 + Z \exp(-\lambda_s t) - 2\beta \exp(-\lambda_s \gamma/2) \sin \Delta m t$. Assuming $\Delta m = 0.75 \times 10^{10}$/sec, we find $Z = -0.7^{+1.2}_{-0.6}$, $\beta = -0.8^{+0.5}_{-0.7}$. The $\Delta S = \Delta Q$ rule prediction is $Z = 1 + 0.6$, $\beta = 0$; the 0.6 is a correction for the $K_s \rightarrow \pi^+ \pi^- \gamma$ process. The likelihood of the $\Delta S = \Delta Q$ prediction is less the maximum by $e^{-0.6}$. T symmetry requires $\beta = 0$. Results are consistent with T symmetry, but one cannot rule out significant T-nonpreserving amplitudes.

Author (NSA)

N66-36967# Mississippi Univ., University. Dept. of Physics and Astronomy.

THE EFFECTS OF NEUTRON IRRADIATION ON THE RESISTIVITY OF BINARY ALLOYS Progress Report

A. B. Lewis 1 Jun. 1966 32 p ref

(Contract AT(40-1)-2891)

(ORO-2891-5) CFSTI: HC $2.00/MF $0.50

Radiation effects data obtained during the past nine month period are summarized, and progress made in operation of the Dynamitron accelerator is reported. A spectrum of the neutrons obtained at various operating levels of the accelerator shows that better beam tubes will speed up data acquisition. Energies of 2.3 MeV and beam currents of 1 ma are produced for long periods with no machine breakdown. A new accelerator tube offers sustained operation at MeV and 4 ma beam current. Lower level operation data reveals the improved spectrum obtainable from a small increase in voltage using the new tube. The new beam tube has not been installed in the present machine. A discussion of targets, and ways of building them is included. NSA

N66-36969# Oak Ridge National Lab., Tenn.

CONSIDERATION OF THE LAWS OF CONSERVATION OF ENERGY AND MOMENTUM IN INELASTIC INTERACTIONS IN THE MONTE CARLO METHOD [UCHET ZAKONOV SOKHRANENIYA ENERGII I IMPUL'SA V NEUPRUGIKH VZAIMODEISTVIYAKH V METHODE MONTE-KARLO]

J. M. Mal'tsev and I. I. P'yanov 1965 15 p Transl. into ENGLISH of Joint Inst. for Nucl. Res. Rept. JINR-P-2140

(ORNL-TR-1064; JINR-P-2140)

A method is given of finding the magnitudes and directions of momenta of n particles emitted in the process of the inelastic interaction of two particles. This method assumes the use of experimental data on the momentum and angular distributions of particles. It is immediately applicable for calculating the intranuclear cascade. Author (NSA)

N66-36972# Oak Ridge National Lab., Tenn.

EXPERIMENTS ON A SYNTHESIS OF SPONTANEOUSLY FISSIONING ISOMER IN THE $^{241}Am(n,\gamma)$ ^{242}Am REACTION [OPYTY PO SINTEZU SPONTANNO DELYASHCHEGOSYA IZOMERA V REAKTSII $^{241}Am(n,\gamma)$ ^{242}Am]

B. N. Markov, A. A. Pleve, S. M. Polikanov, and G. N. Flerov Feb. 1966 6 p refs Transl. into ENGLISH of Joint Inst. for Nucl. Res. Rept. JINR-P-2347

(ORNL-TR-1099; JINR-P-2347)

Data are presented on the character of production of a spontaneously fissionable isomer ^{242}Am in a reaction involving thermal neutrons. The upper boundary for the cross section and magnitude of the isomer ratio are given. Author (NSA)

N66-36976# Sandia Corp., Albuquerque, N. Mex.

TABULATION OF CROSS SECTIONS, Q-VALUES, AND SENSITIVITIES FOR NUCLEAR REACTIONS OF NUCLIDES WITH 14-MeV NEUTRONS

B. T. Kenna and F. J. Conrad Jun. 1966 42 p refs

(Contract AT(29-1)-789)

(SC-RR-66-229) CFSTI: HC $2.00/MF $0.50

This compilation is divided into two parts. The first tabulates target and product isotopes by chemical symbol and mass number, percentage abundance, reaction cross section, half life, decay characteristics, and an indication of sensitivity for (n,γ), $n,\alpha)$, (n,p) and $(n,2n)$ reactions of nuclides with 14-MeV neutrons. The second part lists the target isotope by chemical symbol and mass number, the mass in *ame* based on ^{12}C, and the Q-values in MeV for $(n,2n)$, (n,p) and (n,α) reactions of nuclides with 14-MeV neutrons. Author (NSA)

N66-36977# Washington Univ., St. Louis, Mo.

LOW-ENERGY NUCLEAR REACTIONS AND NUCLEAR SPECTROSCOPY Technical Progress Report, Sep. 15, 1965-Jun. 15, 1966

D. G. Sarantites 15 Jun. 1966 38 p refs

(Contract AT(11-1)-1530)

(COO-1530-1) CFSTI: HC $2.00/MF $0.50

Good progress was made on the research program proposed last year concerning low-energy reactions and nuclear spectroscopy. The level of effort and the accomplishments were about as planned in the theoretical calculations on nuclear reactions, and in the instrumentation for nuclear spectroscopy until the cyclotron became operative (February, 1966) for external irradiations with unmonitored beam. Extensive calculations on the excitation functions of alpha induced reactions on ^{107}Ag and on isomer ratios produced in the same reactions were made of nuclear reactions. Cross section measurements for radiative capture of charged particles have begun. Silicon and germanium detectors were made and systems for mounting and cooling were developed. Apparatus for measurement of angular correlations of the type γ-γ, e^--γ and β^--γ were constructed and used. Decay scheme studies on a number of nuclides have begun. Instrumentation for measurement of charged particle evaporation spectra was assembled and measurements will be undertaken in the near future. Author (NSA)

N66-36979# International Centre for Theoretical Physics, Trieste (Italy).

GENERALIZED NONET REPRESENTATION OF SU(3)×SU(3) AND ITS APPLICATIONS

S. K. Bose May 1966 17 p refs Submitted for Publication

(IC-66/48)

A class of representations of the non-chiral $SU(3) \otimes SU(3)$, is worked out. These consist of a sequence of self-conjugate representations of SU(3), starting always with a singlet and with each SU(3) representation occurring once. An analog of Gell-Mann–Okubo mass formula, valid for these representations of $SU(3) \otimes SU(3)$ is obtained. When applied to the lowest non-trivial representation, this formula correctly explains $\omega - \phi$ mixing, thus providing a justification of Okubo's "ansatz." Possible use of the next higher representation is indicated. From the same construction the corresponding unitary irreducible representations of SL(3,C) and $T_8 \times SU(3)$ are simultaneously obtained. Author (NSA)

N66-36980# International Centre for Theoretical Physics, Trieste (Italy).
CABIBBO ANGLE AND THE NINTH BARYON
T. Pradhan May 1966 7 p refs
(IC-66/59)

Using Fubini–Furlan–Adler–Weisberger type sum rules it was shown by many workers that the renormalized $\Delta S = 0$ and $\Delta S = 1$ axial vector coupling constants are approximately equal if one uses the SU(3) $\otimes$ SU(3) algebra of integrated time components of vector and axial vector currents with the baryons belonging, in the exact symmetry limit, to the (8,1) + (1,8) representation. The Cabibbo cos θ and sin θ factors appearing in the matrix elements of the hadronic weak current cannot therefore be interpreted as renormalization effects due to strong interactions; these have to be taken as phenomenological factors in the hadronic weak current. It is shown that the situation is somewhat different if the baryons are taken to belong to the $(\bar{3},3) + (\bar{3},3)$ representation so that there is a nonet of them instead of an octet. The renomalized $\Delta S = 1$ axial vector coupling constant is then found to be appreciably smaller than the $\Delta S = 0$ axial vector coupling constant showing thereby that a substantial part of the Cabibbo factors can arise from strong interaction effects. It is shown that this result has much more general validity, can be obtained without any assumptions about D currents and without the necessity of using experimental d/f ratio. NSA

N66-36981# International Centre for Theoretical Physics, Trieste (Italy).
PROTOPRODUCTION OF VECTOR MESONS FROM NUCLEONS
Harun ar-Rashid May 1966 27 p refs Submitted for Publication
(IC-66/54)

The photoproduction of rho and omega mesons from nucleons is treated phenomenologically, emphasizing the suitability of choosing a particular set of twelve invariant amplitudes of this process. These are obtained in analogy with Compton scattering from nucleons so that the expressions for the physical observables are closely related in the two cases. Contributions to the amplitudes from nucleon exchange in the direct channel and one-pion exchange in the crossed channel are given and the latter diagram is explicitly compared with the few experimental data available at present. Author (NSA)

N66-36985# Oak Ridge National Lab., Tenn.
SUBPROGRAMS FOR THE SOLUTION OF PROBLEMS IN NEUTRON PHYSICS BY MEANS OF THE MONTE CARLO METHOD [UNTERPROGRAMME ZUR LOESUNG NEUTRONENPHYSIKALISCHER PROBLEME MIT HILFE DER MONTE-CARLO-METHODE]
Ulrich Moeller Feb. 1965 39 p refs Transl. into ENGLISH of Kernforschungszentrum, Karlsruhe Rept. KFK-298
(ORNL-TR-876; KFK-298)

Within the framework of a study for the development of a general Monte Carlo code for reactor physics investigations, a description is given of two auxiliary programs used. The first is a realization of distributions of neutron transport for Monte Carlo problems. For the treatment of neutron transport using the Monte Carlo method, random samples of a series of distributions defined by the integral core are necessary. Methods for the realization of all distributions necessary for neutron transport were given. The methods used were all selected with respect to a decimal computer. Effective cross sections for the Monte Carlo problems were also considered. For the solution of the neutron transport equation used in the Monte Carlo method, the cross section as a stable function of the neutron energy is necessary; a scheme is given for the solution of this problem. An IBM-7070 program is described with which, from the neutron energy the temperature of the material, and a list of isotopes and their densities (atoms/cm^3), the microscopic cross sections in cm^{-1} (capture, elastic scattering, inelastic scattering, fission, and (n,2n) reactions) can be calculated for each isotope given. Constituents of the program are the nuclear data such as resonance parameters, atomic weights, etc. In energy ranges in which the thermal motion of the nucleus plays a role, the cross sections averaged over a Maxwell spectrum of the nuclear velocities are given. The cross sections calculated in the area of statistical resonances are, in the statistical sense, random numbers. In the energy range in which only measurement values of the cross section are present, polynomials were used. Author (NSA)

N66-36986# Oak Ridge National Lab., Tenn.
SOLUTION OF THE TRANSPORT EQUATION BY MEANS OF THE MONTE CARLO METHOD
Ulrich Moeller [1966] 47 p refs Transl. into ENGLISH of the German Rept. KFK-297, Feb. 1965
(ORNL-TR-875)

The theoretical and practical principles of a Monte Carlo code for the treatment of neutron physics problems are given. Monte Carlo methods for Fredholm integral equations of the second type are first considered. A general representation of the Monte Carlo method for Fredholm integral equations of the second type is given. The problem was to produce random samples of given distribution coherent with the solution functions of the integral equations. The usual statistical methods can then be used on these random samples. This makes possible, under some conditions, a very effective utilization of the random transport processes. Monte Carlo methods for the solution of the homogeneous transport equation were also considered. The theoretical principles for a program for the solution of the time-dependent transport equation was given. The use of expected values in place of the straightforward estimated functions which leads to simplification of the program or shortening of the calculation time was treated. It was shown how, with the help of so-called influence factors, the statistics in the individual reactor regions and energy and angular groups can be modified in various ways. The time dependence and the corresponding eigenvalue calculation were discussed extensively. The types of calculations (reaction rates, leakage rates, neutron fluxes, neutron densities, and energy transfer rates) were described. The effective cross section was calculated. Author (NSA)

N66-36987# Oak Ridge National Lab., Tenn.
THE REACTION OF PIONS WITH NUCLEONS IN THE RANGE OF ACCELERATOR ENERGIES
A. Eskreys [1966] 28 p Transl. into ENGLISH from Postepy Fiz. (Poland), v. 16, no. 3, 1965 p 257–278
(ORNL-TR-1151)

The accumulation of experimental results on the interaction of mesons (π) with nucleons is reviewed for mesons (π) energies of 0 to 20 Bev. The experimental data include the total cross section as a function of meson energy and a discussion of the resonance-like structure of this cross section. An analysis of the interaction processes includes elastic scattering cross sections and angular distributions, and production of secondary particles both by direct and resonance interactions. The data are only explained by theory in a fragmentary way, with Regge poles explaining only elastic p-p scattering well, and with the one-particle exchange theory agreeing with experimental only below 2 Bev. The statistical theory appears to be most promising. Many useful models have been developed on the basis of this approach. NSA

N66-36988# Oak Ridge National Lab., Tenn.
SOME CONSIDERATIONS OF BUILD-UP FACTORS IN γ-RAY PENETRATION FOR MULTIPLE LAYERS
Mitsuyuki Kitazume [1966] 8 p refs Transl. into ENGLISH from Nippon Genshiryoku Gakkaishi (Tokyo), v. 7, no. 9, 1965 p 496–499
(ORNL-TR-1134)

The empirical Kalos equation for calculating the buildup factors for gamma ray penetration through multiple layers was used as the standard to which several theoretical treatments were

compared. Calculations were based on 1-Mev gamma ray energy. When two light layers form the shielding material, the additional method gives values that are considerably divergent from the Kalos values. The light-heavy material values also are poor but improve with increasing thickness of the heavy layer. The multiplication method values for light-heavy layers improve with decreasing thickness of the light layer. When heavy-light layers are involved, the agreement becomes worse the thicker the heavy layer. The agreement of the values calculated by the mean free path method is much better for heavy-light layers than with the multiplication method particularly as the light layer becomes thinner. On the other hand, there is about 50% divergence when gamma rays pass from light to heavy layers. The values derived by the average atomic weight method are satisfactory when heavy-light layers are considered, but the reverse light-heavy assembly gives very poor agreement. When the Kalos values are compared with the values obtained by the Broder empirical equation, the agreement for the heavy-light layers case was within 30%. The two sets were rather discordant when the gamma rays were passed through light-heavy layers. The Broder equation was modified to compensate for this divergence. This last equation can be adapted for multiple layers greater than three. NSA

N66-36989# Oak Ridge National Lab., Tenn.
MEASUREMENT OF DOSE BUILD-UP FACTORS OF IRON SLABS FOR A LINE ISOTROPIC SOURCE
Iwao Umeda [1966] 14 p refs Transl. into ENGLISH from Nippon Genshiryoku Gakkaishi (Tokyo), v. 7, no. 9, 1965 p 480–484
(ORNL-TR-1133)

Dose build-up factors were obtained for transmitted γ rays from an infinite line isotropic source through an infinitely extensive slab placed in parallel with the source. In the measurements, an alternative arrangement was adopted, giving results equivalent to the line isotropic geometry with a point isotropic source (about 1 $C^{60}o$ and ^{137}Cs), an air equivalent cylindrical ionization chamber, and iron plates. Up to 1 mean free path slab thickness, the dose build-up factor of the combination of infinite line isotropic source with infinitely extensive iron slab was the same as that with infinite iron medium. For thicknesses of 1 to 3 mean free paths, it was smaller with the former combination by about 7%. In excess of 3 mean free paths, the dose build-up factor of a point isotropic source in an infinite iron medium can be used instead of the infinite line source–infinite slab combination without causing errors beyond 5%. Author (NSA)

N66-36992# Oak Ridge National Lab., Tenn.
RADIATION TRANSPORT THROUGH DUCTS AND VOIDS IN SHIELDS Summary Report
F. W. Krueger and U. E. Michaelis [1965] 64 p refs Transl. into ENGLISH from Kernenergie (Dresden), v. 8, no. 3, Mar. 1965 p 137–162
(ORNL-TR-815)

Discussion is presented on: radiation streaming through irregularities in a shield; radiation streaming through straight ducts; straight empty ducts; collimators and beam holes; partially penetrating ducts; material-filled ducts; radiation streaming through bent ducts; shielding labyrinths; stepped ducts; helical ducts; and radiation streaming through voids including single voids and distributed voids in the shield. 128 references are included. NSA

N66-36996# Oak Ridge National Lab., Tenn.
SUMMARY STUDY OF ACTIVATION BY CHARGED PARTICLES
Charles Engelmann [1965] 18 p Transl. into ENGLISH from French Rept. no. CEA-R-2559 p 33–46
(ORNL-TR-628)

Nuclear reactions obtained by irradiation in γ bremsstrahlung, α particles, and protons are particularly suitable for dosing very small traces of light elements. The possibilities presented by activation in γ radiation of 28 Mev maximum energy are considered, mainly for the measurement of C, F, N, O, P, and S. Non-destructive methods of analysis for beryllium are described. Under certain conditions they may also be used for other elements such as B, Ca, Li, and Na. Results are given of experiments carried out in an attempt to find a method for dosing carbon and oxygen by irradiation in α particles and protons. For each type of activation, the possible interference of other nuclear reactions is considered. Author (NSA)

N66-36999# Oak Ridge National Lab., Tenn. Isotopes Development Center.
AN ELECTROMAGNETIC MASS-SEPARATOR OF THE LABORATORY OF NUCLEAR REACTIONS: A CALCULATION OF THE MAGNETIC ANALYSER FOR THE MASS-SEPARATOR [ELEKTROMAGNITNI MASS-SEPARATOR LABORATORII YADERNIX REAKTSII. I: RASCHET MAGNITNOGO ANALIZATORA MASS-SEPARATORA]
N. I. Tarantin and A. V. Dem'yanov Jul. 1965 13 p refs Transl. into ENGLISH of Joint Inst. for Nucl. Res. Rept. No. JINR-P-1948
(ORNL-TR-834)

A calculation is given of a magnetic analyzer for the mass separator. This analyzer is meant for the mass identification of the radioactive nuclei bombarded with accelerated heavy ions. Author (NSA)

N66-37014# European Organization for Nuclear Research, Geneva (Switzerland).
ENERGY DEPENDENCE OF THE SLOPE OF THE DIFFRACTION CURVES FOR PROTON-PROTON, KAON-PROTON AND PION-PROTON SCATTERING
A. L. Lyusimov 1965 13 p refs Transl. into ENGLISH of Joint Inst. of Nucl. Res. Rept. JINR-P-2202, 1965
(NP-TR-1316; JINR-P-2202)

It is known that, between a few GeV and the highest energies reached in accelerators, the diffraction peaks in pp and K^+p elastic scattering shrink, whereas there is no shrinking for $\pi^{\pm}p$ and K^-p scattering, and for $\bar{p}p$ scattering the diffraction cone is even observed to expand as the energy increases. The aim of these notes is to show that in spite of the absence of universality in the behaviour of the slope of the diffraction curves for the above-mentioned elastic scattering processes in the energy range considered, this behaviour can be described in a unique manner within the limits of experimental error. This description is based on the existence for all scattering processes of an identical shrinking of the diffraction. Author

N66-37016# European Organization for Nuclear Research, Geneva (Switzerland).
POSSIBLE CP VIOLATION AND THE NATURE OF THE $\Delta T = 1/2$ RULE
V. Ya. Zel'dovich and L. B. Okon [1966] 6 p refs Transl. into ENGLISH from Phys. Letters (USSR), v. 16, 1965 p 319
(NP-TR-1282; ITEF-343)

The Wolfenstein model is discussed, in which the $K_2^0 \to 2\pi$ decay is due to the difference in phase of the primary non-leptonic interaction and of the non-leptonic interaction that appears in the second order of perturbation theory due to the virtual lepton exchange. It is shown that in order to get an observable scale of CP violation it is necessary in this model to abandon the non-leptonic interaction Lagrangian in the form of the product of charged currents. This suggests that the primary non-leptonic Lagrangian satisfies the strict $\Delta T = 1/2$ rule. Author (NSA)

N66-37017# European Organization for Nuclear Research, Geneva (Switzerland).
EXPERIMENTAL DETERMINATION OF THE DISTRIBUTION OF LOCAL ENERGY LOSSES (LEL) AND OF THE QUALITY FACTOR OF IONIZING RADIATION [METODY EKSPERIMENTAL'NOGO OPREDELENIYA LPE RASPREDELENII I FAKTORA KACHESTVA PRONIKAYUSHCHEGO IZLUCHENIYA]
V. H. Lebedev 1965 16 p refs Transl. into ENGLISH of Joint Inst. of Nucl. Res. Rept. JINR-P-2089, 1965
(NP-TR-1267; JINR-P-2089)

Problems related to practical determination of radiation danger in the field of unknown mixed radiation demanding a fast mean determination of the radiation quality and ionization along the total local absorption energy (LAE) spectrum were resolved by recombination method. The problems of biological effects with variable local absorption energy demanding much more precise answers were resolved by the Rossi–Rozensweig method. NSA

N66-37021# Comitato Nazionale per l'Energia Nucleare. Frascati (Italy). Servizio Documentazione.
CALCULATION OF THE SHIELDING AROUND ALL TARGETS OF THE FRASCATI LINEAR ACCELERATOR [CALCOLO DELLE SCHERMATURE INTORNO ALLE TARGHETTE DEL' ACCELERATORE LINEARE DI FRASCATI]
M. Pelliccioni 8 Mar. 1966 14 p refs In ITALIAN *Its* Nota Interna no. 313
(LNF-66/14)

A calculation is made of the shielding around those points of the Frascati linear accelerator in which the power of the beam is either partially or totally absorbed. The two areas considered are the tungsten target and the collimator at the end of the accelerator with which the electrons collide with an energy of 400 MeV. In the calculations only the contributions of the neutrons are considered. Numerical results are tabulated. Author (NSA)

N66-37044*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
AN IMPROVED ANALYSIS OF SPHERE TRANSMISSION EXPERIMENTS FOR AVERAGE CAPTURE CROSS SECTIONS
Donald Bogart Washington, NASA, 1966 17 p refs Presented at Conf. on Nucl. Data—Microscopic Cross Sect. and Other Data Basic for Reactors, Paris, 17–21 Oct. 1966
(NASA-TM-X-52235) CFSTI: HC $1.00/MF $0.50

Monte Carlo calculations that account directly for energy-dependent cross sections and multiple-scattering processes in the sphere experiments provided significantly larger values of capture cross sections $\overline{\sigma}_C$ as a result of including effects of resonance scattering. The consequences are particularly important for Au, for which interpretation of the same experiments provides a value of $\overline{\sigma}_C$ at 24 keV of 635±60 mb by Bethe analysis with a resonance self-protection correction. The problem in applying the Bethe method when microscopic cross sections are energy dependent may be reduced to the determination of an effective scattering cross section. By comparing values of average capture cross sections obtained from the Monte Carlo analyses with values obtained from the Bethe analyses for Ag, Sb, I, and Au, a suitable criterion was obtained. The use of the potential scattering cross section in the Bethe analysis was shown to provide results that were in reasonable agreement with the Monte Carlo results without the necessity for applying resonance self-protection corrections. Author

N66-37055*# Columbia Univ., New York. Nevis Labs.
RADIATION DECAY OF THE MUON
Elliot Bogart (Ph.D. Thesis) May 1966 95 p refs
(Contract Nonr-266(72))
(CU-255; R-551; NEVIS-151; AD-635846) CFSTI: HC $3.00/MF $0.75

The radiative decay of the muon, $\mu^+ \rightarrow e^+ + \nu + \nu_e + \bar{\nu}_\mu$, was measured using muons from the Columbia University Nevis Synchrocyclotron. The positron and gamma-ray decay products were observed at relative angles near 180 degrees, using scintillation counters and two 9 in. × 10 in. NaI crystals, which enabled simultaneous measurement of the positron and gamma energies. The pulses from the crystals were displayed on oscilloscopes and photographed, and the measured amplitudes of these pulses were calibrated using the positron spectrum of the nonradiative decay. The two-dimensional energy spectrum for positrons and gammas was obtained for about 900 events, after subtraction of background. This spectrum and the measured rate, obtained by normalizing to the nonradiative decay, were compared with theoretical predictions for the radiative decay. The results were in good agreement with the theory, within statistics, for the case of pure V-A coupling. Author (TAB)

N66-37090# AVCO–Everett Research Lab., Everett, Mass.
BREMSSTRAHLUNG IN AIR
B. Kivel Jun. 1966 20 p refs Submitted for Publication
(Contract AF 29(601)-7055)
(AVCO-Everett Res. Rept.-249; AD-636036) CFSTI: HC $1.00/MF $0.50

The partial wave analysis for Bremsstrahlung and elastic scattering by molecular nitrogen is reviewed. These studies suggest that the Bremsstrahlung in the field of molecular nitrogen can be estimated from the measured momentum transfer cross section. Using this approximation for the molecular components and recent calculations of Bremsstrahlung in the field of atomic oxygen and nitrogen, the emissivity and intensity from neutral Bremsstrahlung in high temperature air is estimated. Author (TAB)

N66-37216*# Oak Ridge National Lab., Tenn.
NEUTRON PHYSICS DIVISION Annual Progress Report, Period Ending 31 May 1966
Sep. 1966 46 p refs
(NASA Order R-104; Contract W-7405-ENG-26)
(NASA-CR-78263; ORNL-3973, Vol. II) CFSTI: HC $2.00/MF $0.50 CSCL 18F

The results of theoretical and experimental studies on high energy radiation shielding and radiation detector studies are summarized. R.N.A.

N66-37264# Carnegie Inst. of Tech., Pittsburgh, Pa. Dept. of Physics.
COMPLETE NUMERICAL SOLUTION OF BOHR'S COLLECTIVE HAMILTONIAN
Krishna Kumar (Michigan State Univ.) and Michel Baranger Jun. 1966 104 p refs Submitted for Publication Prepared in Cooperation with Michigan State Univ.
(Contracts Nonr-760(15); AT(11-1)-1051)
(TR-24; AD-635618) CFSTI: HC $4.00/MF $0.75

The general form of Bohr's collective Hamiltonian for quadrupole deformations is reviewed. It contains seven largely arbitrary functions of beta and gamma, the potential energy and six inertial functions. A thorough discussion is given of the symmetries of these seven functions and of the Schrodinger equation. A purely numerical method involving a finite mesh is developed for solving this Schrodinger equation. The output of the calculation consists in the low-lying levels, the corresponding wave functions, and the relavant E2 and M1 static and transition moments; the latter depend on the intrinsic quadrupole moments and intrinsic gyromagnetic ratios as functions of beta and gamma. The numerical method is tested on a number of examples and is found to be sufficiently accurate for application to spherical, transition, and many deformed nuclei. Author (TAB)

N66-37271*# Research Triangle Inst., Durham, N. C. Measurement and Controls Lab.

A THEORETICAL STUDY OF THE GAMMA-RAY SCATTERING TECHNIQUE FOR MEASURING ATMOSPHERIC DENSITY Final Report

R. P. Gardner and D. R. Whitaker Aug. 1966 58 p refs (Contract NAS1-5467)

(NASA-CR-66142) CFSTI: HC $2.50/MF $0.75 CSCL 18D

This report describes a theoretical, mathematical modeling study of the gamma-ray scattering technique for measuring atmospheric density. A basic model was derived which describes the response of this technique in a cylindrically symmetrical geometry like that used to date in prototype gauges flown in Nike-Apache vehicles. Two other models were derived to describe the response of a gauge of this type in a steel wall vacuum sphere and the response to gamma-ray streaming down the rocket walls. An existing Monte Carlo calculation was used to calculate shield effectiveness. The predicted gauge response was linear with atmospheric density, independent of atmospheric composition if gamma-ray energies larger than 0.1 Mev are employed, effected by atmospheric density as far as 10 meters from the rocket, and independent of shock wave density perturbations that are likely to be encountered. The sensitivity of the gauge is at a maximum for air at a gamma-ray energy of .038 MeV and depends on the reciprocal of the source-to-detector distance. The significant problems identified are: (1) inaccurate calibration technique, (2) a high background response due to gamma-ray streaming down the rocket wall, and (3) a dependence on atmospheric composition if gamma-ray energies less than 0.1 Mev are used. Author

N66-37276*# New Hampshire Univ., Durham. Dept of Physics.

INVESTIGATION OF ENERGY LEVELS IN FOIL EXCITED ATOMIC BEAMS Semiannual Status Report, 1 Feb.-31 Jul. 1966

E. L. Chupp and L. W. Dotchin 29 Aug. 1966 14 p refs (Grant NGR-30-002-018)

(NASA-CR-78153) CFSTI: HC $1.00/MF $0.50 CSCL 20H

In experiments with the foil method of excitation on the relative population and mean lifetimes of some levels in atomic beams of hydrogen and helium, the fall-off in intensity of several spectral lines was measured as a function of time from the point of initial state population. The lines investigated were the 4861 Å and 1215 Å lines of H(I), and the 4859 Å, 3889 Å, and 4686 Å lines of He(I) and He(II). Problems connected with data analyses are discussed; it was found that, in preliminary analysis of Lyman α-data, the best fit to the data is at least the sum of two exponentials. M.G.J.

N66-37323*# California Univ., Riverside. Dept. of Physics.

A MODIFIED OPTICAL POTENTIAL APPROACH TO LOW-ENERGY ELECTRON-HELIUM SCATTERING

Robert T. Pu and Edward S. Chang [1966] 39 p refs (Grant NGR-05-008-005)

(NASA-CR-78155) CFSTI: HC $2.00/MF $0.50 CSCL 20F

This approach has the advantage that one may include the effect of second order optical potential without recourse to the usual adiabatic approximation. The diagramatic approach associated with the present method makes it possible to identify different contributing terms with different physical effects, and thus to assess the relative importance of various physical effects involved in the scattering process. To test the approach as a practical method for low energy electron-atom scattering, we applied it to the case of electron-helium scattering for energy range 1.2 ev. to 16.4 ev. Good agreement with available experimental data has been obtained. The contributions of various multipole components in the second order optical potential are examined. In particular, the effect of exchange in second order optical potential, usually neglected in most calculations, was found to be very significant. Author

N66-37327# International Centre for Theoretical Physics, Trieste (Italy).

NON-LEPTONIC DECAYS OF Ω^-

Y. Hara 31 May 1966 10 p refs Submitted for Publication (IC-66/57)

By making use of the PCAC hypothesis and equal time commutation relations suggested by the quark model, it was found that (i) asymmetries of Ω^- non-leptonic decays ($\Omega^- \rightarrow \Lambda + K$, $\Xi + \pi$ and $\Xi^* + \pi$) are very small, (ii) the lifetime of Ω, $\tau(\Omega) \approx (0.3 \sim 0.8) \times 10^{-10}$ sec, (iii) $\Gamma(\Omega \rightarrow \Lambda K)/\Gamma(\Omega \rightarrow \Xi\pi) \leq 1/30$ for the SU(3)-symmetric $B_{10}\, B_8\, P_8$ coupling and $\sim(1/10 \sim 1/5)$ for the broken SU(3)-symmetric $B_{10}\, B_8\, P_8$ coupling and (iv) $\Gamma(\Omega^- \rightarrow \Xi^*\pi)/\Gamma(\Omega^- \rightarrow \Xi\pi) \approx 1/3$. Author (NSA)

N66-37330# Gosudarstvennyi Komitet po Ispolzovaniyu Atomnoi Energii, Moscow (USSR). Institut Teoreticheskoi i Eksperimental'noi Fiziki.

CONVERSION ELECTRONS ASSOCIATED WITH α DECAY OF Am^{241} AND LEVEL SCHEME OF Np^{237} [KONVERSIONNYE ELECTRONYI SOPROVOZHDAYUSHCHIE α-RASPAD ^{241}Am I SKHEMA UROVNEI ^{237}Np]

L. N. Kondrat'ev and E. F. Tret'Yakov 1965 17 p refs In RUSSIAN; ENGLISH summary (ITEF-351)

Spectra of the α-e coincidences of ^{241}Am were measured by means of the ITEF double thoroidal β-spectrometer. Transitions from some high-energy levels of ^{237}Np were found; the transition from the 723-kev level was found for the first time. Energies and intensities of some weak transitions were remeasured more precisely. The level scheme of ^{237}Np was discussed. Author (NSA)

N66-37331# Kernforschungszentrum, Karlsruhe (West Germany). Institut fuer Radiochemie.

THE MATHEMATICAL TREATMENT OF THE DECAY AND FORMATION LAWS OF RADIOACTIVITY WITH GRAPHICALLY SOLVED EXAMPLES [DIE MATHEMATISCHE BEHANDLUNG DER ZERFALLS- UND BILDUNGSGESETZE DER RADIO AKTIVITAET MIT GRAFISCH GELOESTEN BEISPIELEN]

W. Seelmann-Eggebert, J. Flegenheimer, and G. Pfennig Jul. 1965 33 p refs In GERMAN; ENGLISH Summary (KFK-117)

Lectures on decay laws and the formation of radioisotopes by nuclear reactions, that were given in connection with radiochemical laboratory courses in Buenos Aires, Mainz, and Karlsruhe, are presented. NSA

N66-37332# California Univ., Livermore. Lawrence Radiation Lab.

GENERAL NON-DYNAMICAL FORMALISM FOR REACTIONS WITH PARTICLES OF ARBITRARY SPIN. NUMBER OF FORM FACTORS. PARITY CONSERVATION

Paul L. Csonka, Michael J. Morancsik, and Michael D. Scadron Dec. 1965 93 p refs (Contract W-7405-ENG-48)

(UCRL-14582-T, Rev. 1) CFSTI: HC $3.00/MF $0.75

The general non-dynamical formalism for reactions involving particles of arbitrary spins is further developed. The number of form factors in the M-matrix is determined under parity conservation as well as other conservation laws, and from this it is derived that many conservation laws have no non-dynamical tests of validity in reactions involving spin-zero particles only. The factorization of the M-matrix into irreducible constituents is developed for parity conserving reactions and it is shown how the compound observable can be written down in terms of observables and so-called pseudo-observables of the constituent reactions. It is then

demonstrated that for parity conserving reactions, an unpolarized and uncorrelated particle is in general equivalent to a fictitious spin-zero particle possessing both positive and negative parity (dual particle). The structure of observables in terms of the type of traces they contain is studied. The number of terms in a compound observable is derived. It is shown that the number of observables in a parity conserving reaction is always larger than the number of independent bilinear combinations of form factors. Thus, there are always linear relations among the observables. The number and character of these relations are explored and it is shown that they also lead to the complete list of parity experiments, i.e., experiments from which one can determine the intrinsic parity of one of the particles in the reaction, knowing the intrinsic parities of the other participating reactions but knowing nothing about the dynamics of the reaction. It is shown that the observables can be divided into subclasses, a given subclass containing observables which are different linear combinations of the same bilinear combinations of form factors. Each such bilinear combination appears in one and only one subclass. Author (NSA)

N66-37335# General Electric Co., Schenectady, N. Y. Knolls Atomic Power Lab.
DOUBLE DIFFERENTIAL SCATTERING CROSS SECTIONS AND SCATTERING LAW FOR H_2O AT 302°K
G. J. Kirovac, W. E. Moore, and K. W. Seemann Jan. 1966 30 p refs
(Contract W-31-109-ENG-52)
(KAPL-M-6536) CFSTI: HC $2.00/MF $0.50

Inelastic neutron scattering cross sections for H_2O at 302°K were obtained with a linear accelerator-phased chopper time-of-flight spectrometer. Data were accumulated for nine incident neutron energies from 0.15 to 1.8 ev and at three scattering angles: 25, 60, and 90°. The measured double differential neutron scattering cross section, and the scattering law obtained from it, are presented in tabular form. The scattering law, $S(\alpha,\beta)$, obtained by interpolating the experimental date, is tabulated for twenty integer values of β, the dimensionless energy transfer parameter. Author (NSA)

N66-37415*# National Aeronautics and Space Administration, Electronics Research Center, Cambridge, Mass.
ABSOLUTE PHOTON YIELDS OF LIGHT ELEMENTS BY DEUTERON BOMBARDMENT
Anthony J. Caruso and Robert A. Walter Washington, NASA, Oct. 1966 14 p refs
(NASA-TN-D-3648) CFSTI: HC $1.00/MF $0.50 CSCL 20H

Absolute measurements of K X-ray quantum yields resulting from deuteron bombardment of thick targets containing the elements carbon and boron were made. Characteristic X-rays for deuteron energies ranging from 0.75 to 1.3 MeV were analyzed by pulse-height distributions obtained with a proportional counter. The proportional counter contained a Mylar-aluminum window for carbon radiation and a polypropylene window for boron radiation and was operated with P-10 gas (90% argon and 10% methane) flowing at atmospheric pressure. Deutrons were incident normal to the target surface and the photons were detected at 45° to the target. The results of the photon yields for carbon K ranged from 0.567×10^{-4} at 0.75 MeV to 3.17×10^{-4} photons per deuteron per steradian at 1.3 MeV; and for boron K, from 0.394×10^{-4} at 0.75 MeV to 1.15×10^{-4} photons per deuteron per steradian at 1.3 MeV. In all measurements, the uncertainty was less than 10 percent. Author

N66-37435# Illinois Univ., Urbana. Dept of Physics.
ANALYSIS OF THE REACTION $\gamma+p \rightarrow \eta+p$ NEAR THRESHOLD
R. K. Logan and F. Uchiyama-Campbell [1966] 9 p refs
(Contracts Nonr-1834(05); AT(11-1)-1018)
(AD-635969) CFSTI: HC $1.00/MF $0.50

The recent measurements of eta photoproduction, $\gamma+p \rightarrow \eta+p$, reveal an enhancement of the cross section, σ_γ, just above threshold. This is very similar to the enhancement of the $\pi^-+p \rightarrow \eta+n$ cross section, σ_π, which we have shown can be explained by an S wave resonance with an approximate mass and width of 1560 and 150 MeV respectively. It is shown that this resonance can also explain the enhancement of σ_γ. TAB

N66-37498# Aktiebolaget Atomenergi, Stockholm (Sweden).
POSSIBLE ODD PARITY STATE IN Xe-128
Sven G. Malmskog and Lars Broman (Chalmers Univ. of Technol.) Jul. 1966 12 p refs
(AE-240) CFSTI: HC $1.00/MF $0.50

Gamma lines in the decay of ^{128}I have been measured by means of a Ge(Li) detector. The following gamma ray energies have been obtained: 442.5±0.05, 526.5±0.5, 742.4±1.0, 969.0±1.0, and 1136.5±2.0 keV. The 1136.5 keV transition defines a level in ^{128}Xe at 1579±2 keV. From the log ft=7.8±0.3 of the β^- feeding, this level is believed to have an odd parity. Upper limits of gamma ray intensities for transitons around 530 keV are used to set a limit for the population of the expected 0^+ level originating from the two-phonon quadrupole vibration. Author (ESRO)

N66-37504# Aktiebolaget Atomenergi, Stockholm (Sweden).
MICROANALYSIS OF FLUORINE CONTAMINATION AND ITS DEPTH DISTRIBUTION IN ZIRCALOY BY THE USE OF A CHARGED PARTICLE NUCLEAR REACTION
E. Moeller and N. Starfelt Jul. 1966 17 p refs
(AE-237)

Fluorine contamination on the below the surface of Zircaloy has been studied by means of proton irradiation using a Van de Graaf accelerator and the detection of prompt gamma radiation from the $F^{19}(p,\alpha\gamma)O^{16}$ reaction. Formulas for deriving depth distributions of impurities from the measured counting rates have been derived. The influence of energy straggling on the depth resolution has been studied. Both the total amount and the depth distribution have been measured in samples, which have undergone different treatments. Because of the high yield from the reaction used, a quantity of fluorine less than $0.01\,\mu g/cm^2$ can be detected by this method. Author (ESRO)

N66-37538*# Oak Ridge National Lab., Tenn.
DIFFERENTIAL CROSS SECTIONS FOR THE PRODUCTION OF PROTONS IN THE REACTIONS OF 160-MEV PROTONS ON COMPLEX NUCLEI
R. W. Peelle, T. A. Love, N. W. Hill, and R. T. Santoro Sep. 1966 105 p refs
(NASA Order R-104(1); Contract W-7405-ENG-26)
(NASA-CR-78298; ORNL-3887) CFSTI: HC $4.00/MF $0.75 CSCL 18K

Differential cross sections in angle and energy were obtained by flight-time spectrometry for secondary protons above 20 MeV from 160-MeV protons on Be, C, H_2O, Al, Co, and Bi targets. Enough angles were studied for rough angular distributions to be presented for aluminum and cobalt. All secondary charged particles were assumed to be protons, for which the energy resolution varied from 25 to 50%. The observed differential cross sections change smoothly with angle and target mass, and show no peak corresponding to quasi-free scattering near the energy corresponding to free nucleon–nucleon scattering. The measurements are compared with others available at the same energy and with intranuclear cascade estimates, including evaporation. The observed cross sections are larger than the estimated ones at angles of 90 and 120° and at low energies for angles more forward than 45°. At 60° the observed cross sections are in accord with the Monte Carlo estimates. Author

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N66-37552# Atomic Energy Establishment, Winfrith (England). Water Reactor Physics Div.

CHARACTERIZATION OF THERMAL SPECTRA BY INTEGRAL TECHNIQUES

W. N. Fox Jul. 1964 46 p refs

(AEEW-R-342)

The methods adopted measure the Lu176 to Mn55 reaction rate ratio and the Pu239 to U235 fission rate ratio by observing the activity induced in foils exposed in the lattices. The same technique has been applied to both critical and sub-critical experiments and covers a wide range of "spectrum hardness". Check measurements of the fission rate ratio using 1/4" D. fission chambers are also reported, together with an assessment of the possible errors involved in both foil and chamber methods. Finally, the results of measurements made in a number of lattices of the S.G.H.W. type are compared with predictions made using multi-group diffusion and transport theory computer codes. Author

N66-37560*# Arizona Univ., Tucson. Dept. of Physics.

A TWO-TEMPERATURE STATISTICAL MODEL FOR PARTICLE PRODUCTION AT HIGH ENERGIES

J. R. Wayland and T. Bowen 21 Jul. 1966 24 p refs

(Grant NGR-03-002-071)

(NASA-CR-78380) CFSTI: HC $1.00/MF $0.50 CSCL 20H

With the assumption of two characteristic temperatures, one associated with the transverse momentum distribution, the other with the longitudinal, the differential cross section, $d^2N/dpd\Omega$, is calculated from the relativistic quantum statistical mechanical number density. Good agreement with experimental data for pions, kaons, and antiprotons is obtained by the fitting of T_o, the transverse temperature, T, the longitudinal temperature, and V_o, the interaction volume. The model is related to a simple physical interpretation. Author

N66-37561*# Princeton Univ. Observatory, N. J.

DIPOLE TRANSITION INTEGRALS FOR NON-METAL RESONANCE TRANSITIONS

G. M. Lawrence 20 Apr. 1966 18 p refs

(Grant NsG-414)

(NASA-CR-78378) CFSTI: HC $1.00/MF $0.50 CSCL 20H

By formulating a numerical analog of the Bates–Damgaard Coulomb approximation for dipole transition probabilities, but with a Thomas–Fermi potential, transition probabilities are calculated for $p^n - p^{n-1}$.s transitions as a function of empirical energies. The variation of the calculated values with atomic number is found to be approximately factorable. The formulation obtains radial wavefunctions by solution of an initial value problem. Extension of the Bates–Damgaard tables are given for p ground states and s excited states of neutral atoms. The scaled Thomas–Fermi or quantum defect methods are recommended for ions. For intermediate weight atoms, agreement with experiment is found within 30%. Errors of 40% or more are found in C, N, Pb, and I, where failure of the configuration assignments is the probable cause. The Burgess–Seaton quantum defect method is found to give results −10%+80% different from the present formulation. Author

N66-37563*# Princeton Univ., N. J.

RESONANCE TRANSITION PROBABILITIES IN INTERMEDIATE COUPLING FOR SOME NEUTRAL NON METALS

George Lawrence [1966] 23 p refs Submitted for Publication

(Grant NsG-414)

(NASA-CR-78374) CFSTI: HC $1.00/MF $0.50 CSCL 20H

Intermediate coupling calculations are made for the ground configuration and 1st excited s configuration of neutral Si, Ge, Sn, Pb, P, As, S, Se, Cl, Br, and I. The similar calculations for Si, Ge, Sn, and Pb by Khokhlov are confirmed. Tables of wavelengths, line strengths, transition probabilities, and spin orbit parameters are given. Experimental rediative lifetime data are used to provide an absolute scale and thus values of σ^2. Some radiative lifetime measurements by the phase shift method in Gel, Sil, Snl, Cll, and I I are reported. The absolute scale accuracy is ±20%. The relative scale accuracy is thought to be ≈ 10% for strong lines, and 30-100% for intersystem lines. Author

N66-37604*# Union Carbide Research Inst., Tarrytown, N. Y. Space Science and Engineering Group.

THEORETICAL CALCULATIONS OF THE BREMSSTRAHLUNG CROSS SECTION

Clayton D. Zerby and Henry Brysk 24 Jun. 1966 93 p refs

(Contracts NASw-1235; NASw-906)

(NASA-CR-78314; UCC/DSSD-206) CFSTI: HC $3.00/MF $0.75 CSCL 20H

The mathematical analysis and the computer programming used in calculating the Bremsstrahlung cross section are presented. The theoretical development incorporated into the current computer program is presented together with a discussion of the program itself. Also included is the significant work on the problem that is not utilized in the current form of the program along with a discussion of the reasons for its present exclusion and of the advisability of its consideration for future refinements of the program. R.N.A.

25 PHYSICS, PLASMA

Includes magnetohydrodynamics. For applications see: 28 Propulsion Systems.

N66-36456# United Kingdom Atomic Energy Authority, Culham (England). Research Group.

ENERGY SPREADING AND STABILISATION OF PLASMA BY APPLICATION OF A HIGH FREQUENCY ELECTRIC FIELD

L. G. Kuo-Petravić, M. Petravić, D. R. Sweetman, E. G. Murphy, R. M. Sinclair et al Jul. 1966 7 p refs Submitted for Publication

(CLM-P-108) CFSTI: HC $1.00/MF $0.50

The ion cyclotron instabilities in the PHOENIX high energy injection mirror machine have been suppressed by applying oscillating electric fields. Two instabilities appear to be present. One is suppressed by energy spreading and the suppression of the other appears to be due to the effect of the applied electric fields on the electrons. Author

N66-36605# United Kingdom Atomic Energy Authority, Culham (England). Translation Office.

PHENOMENA ACCOMPANYING THE FORMATION OF A DENSE PLASMA FOCUS DURING THE IMPLOSION OF A NON-CYLINDRICAL Z-PINCH

N. V. Filippov and T. I. Filippova Apr. 1966 15 p refs Transl. into ENGLISH of Rept.-IAE-913 of I. V. Kurchatov Inst. (Moscow), 1965 p 1–15

(CLM-TRANS-7) HMSO: 1s 9d

Investigations were continued of the central region of a discharge in deuterium in a pinch device with a metal chamber of larger volume than that used previously. The velocities of the plasma sheath (up to 4×10^7cm/sec) were determined by means of streak photographs and also by a new technique based on the modulation of the X-ray emission from the electrode. Both the quantity (over 10^{14}) and hardness (100–300 keV) of the γ-quanta increase with a decrease in the initial pressure, whereas the neutron emission shows the opposite behavior and has a maximum at p = 1.2 Torr. Neutron time-of-flight measurements showed that despite the anisotropy observed in the axial direction the number of neutrons is practically independent of the degree of anistropy. Simultaneously, with an accuracy better than 5%, complete isotropy of neutron intensity was observed. To explain the observed facts a moving boiler mechanism is proposed. The neutron yield and the

soft X-ray intensity were stabilized and increased by a 2% addition of xenon to the deuterium. The energy content at the focus of the pinch, estimated from the damage to the electrode surface, was approximately 100 kJ cm^{-3}, or nT = 10^{23}–10^{24}eV cm^{-3}. Such an energy content corresponds to a density of $(1-3) \times 10^{20} cm^{-3}$ or a pinch radius smaller than 0.5 mm. Author

N66-36625# United Kingdom Atomic Energy Authority, Culham (England). Research Group.

THE PHOENIX II INJECTOR AND BURIAL LINE COMMISSIONING

D. P. Hammond and D. R. Sweetman May 1966 17 p refs Presented at the 4th Symp. on Eng. Probl. in Thermonucl. Res., Frascati, Italy, May 1966

(CLM-R-59) HMSO: 1s 9d

The main requirements for the neutral particle injection systems of PHOENIX II are that a low divergence high intensity beam of neutral particles of appropriate energy be produced, and that the accompanying flow of cold gas into the plasma trapping region be reduced to the minimum. The injector and burial line components are described and the quantities of gas evolved from various parts of the line are discussed. Measurements were made of the speed of the various pumping units and an estimate is made of the contribution of each source of gas to the center chamber pressure. Author

N66-36653# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.

ON THE CONVECTIVE INSTABILITY OF A COMPRESSIBLE FLUID IN MAGNETOHYDRODYNAMICS

A. A. Rukhadze *In its* J. of Appl. Mech. and Tech. Phys. 16 Feb. 1966 p 275–282 refs (See N66-36628 22-23) CFSTI: HC $7.00/MF $1.75

Reviewed is an approximation method of geometric optics, solving the problem about convective instability of a compressible ideally conducting fluid located in the field of gravity for a certain equation of state of liquid. The dispersion equation obtained is analyzed in the region of high and low frequency oscillations of a nonhomogeneous fluid. It is shown that a conducting fluid in the field of gravity may be unstable only with respect to low-frequency, magnetohydrodynamic oscillations, and a condition of instability generalizing the well-known criteria of convective instability obtained earlier is mentioned. R.Ll.

N66-36658# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.

ABOUT ESTABLISHED MOTION OF ELECTROCONDUCTING FLUID IN A RECTILINEAR CHANNEL DURING PRESENCE OF TRANSVERSE MAGNETIC FIELD

O. A. Berezin *In its* J. of Appl. Mech. and Tech. Phys. 16 Feb. 1966 p 310–316 refs (See N66-36628 22-23) CFSTI: HC $7.00/MF $1.75

Consideration is given to the established motion of an electroconducting fluid in a rectilinear channel whose lateral walls are ideally conducting, and the upper and lower, nonconducting. The solution to the problem is presented in one infinite system of algebraic equations, which may be solved by a method of successive approximations. Included is an approximate solution at large, Hartman–number values. R.Ll.

N66-36660# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.

INFLUENCE OF MAGNETIC FIELD ON OPTIMUM COMPOSITION OF AN ELECTROCONDUCTIVE GAS MIXTURE

E. P. Zimin and V. A. Popov *In its* J. of Appl. Mech. and Tech. Phys. 16 Feb. 1966 p 323–328 refs (See N66-36628 22-23) CFSTI: HC $7.00/MF $1.75

Summarized is previous work about the magnet field influence on the optimum composition of an electroconductive gas mixture. It is stated that in the presence of a magnetic field the electrical conductivity becomes a function of magnetic field strength and acquires an anisotropic character. Discussed is the condition of maximum transverse electric conductivity of a mixture of a practically nonionizing gas (diluent) with a gas having a low ionization potential admixture in the presence of a magnetic field. It is also stated that at a fixed pressure value beginning from a certain value H at which optimum concentration of a readily ionized admixture is still relatively small, the latter practically ceases to depend on the nature of the diluent. With a decrease in pressure, marked peculiarity begins to manifest itself at smaller values of magnetic field strength. At specific values of magnetic field strength H_m the optimum value of the relative concentration of the readily ionized admixture becomes equal to unity, when the pure vapors of the readily ionized admixture possess maximum electric conductivity. R.Ll.

N66-36661# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.

CERTAIN METHODS OF INVESTIGATING THE DYNAMIC STRUCTURE OF PLASMA FLOWS

A. M. Trokhan *In its* J. of Appl. Mech. and Tech. Phys. 16 Feb. 1966 p 329–337 ref (See N66-36628 22-23) CFSTI: HC $7.00/MF $1.75

Certain methods of measuring the velocity fields of plasma flow are reported. The high resolution, ease of operation, and great reliability of a photoregister, a photographic recording instrument, are mentioned. The registration of transit time of optical heterogeneities by photomultipliers was used to measure the gas flow speed in an alternating current plasmatron. To obtain statistical characteristics of the flux, a differential analysis was made of the transit time probability of optical heterogeneities. The differential function of probability of transit of heterogeneities was used in determining the statistical position of the vector of flux speed. This method is convenient for the study of turbulence and may be applied also to both plasma and a cold gas. Included is a measurement method using photoelectric transducer. R.Ll.

N66-36663# Deutsche Versuchsanstalt fur Luft- und Raumfahrt, Stuttgart (West Germany). Institut fuer Plasmadynamik.

EXPERIMENTAL INVESTIGATIONS ON ELECTRIC ARC PHENOMENA IN A RAPIDLY EXPANDING PLASMA FLOW [EXPERIMENTELLE UNTERSUCHUNGEN UEBER LICHTOBGENVORGAENGE IN EINER RASCH EXPANDIERENDEN PLASMASTROEMUNG]

Helmut Huegel Apr. 1966 45 p refs In GERMAN; ENGLISH summary

(DLR-FB-66-30– DVL-502) CFSTI: HC $2.00/MF $0.50

The specific impulse of electrothermal thrustors is limited to about 1500 s. Additional thrust-producing mechanisms have to be applied in order to increase the exhaust velocities. They concern electromagnetic forces which result from the interaction of arc current and magnetic fields. A device designed for the study of these effects is discussed. The experiments carried out so far concern mainly its operational condition. Current–voltage characteristics, pressures and pressure ratios, energy losses and thrust as functions of arc current (up to 1000 A) and mass flow rate (Ar) are discussed. Author

N66-36788*# Colorado State Univ., Fort Collins.

LANGMUIR PROBE MEASUREMENTS

In its Transient and Steady Performance of an Ion Rocket Thrust Augmentor Jan. 1966 10 p refs (See N66-36786 22-28) CFSTI: HC $4.00/MF $1.00

A description is given of an experiment involving probe measurements in plasmas. A general background theory is given which considers a single probe connected to a voltage source and immersed in a uniform plasma. The experimental probe, consisting of a small tungsten wire connected to a variable power supply, was constrained to move along a line mutually at right angles to the beam axis and the locus of hot wire probe. The case

was somewhat similar to that treated by Langmuir for a beam of electrons having a high drift velocity and a small superimposed Maxwellian distribution. Various plots are included which show probe characteristics for different beams measured essentially on axis and at the beam edge. C.T.C.

N66-36789*# Colorado State Univ., Fort Collins.
SECONDARY ELECTRON EMISSION
Robert Bunney *In its* Transient and Steady Performance of an Ion Rocket Thrust Augmentor Jan. 1966 17 p (See N66-36786 22-28) CFSTI: HC $4.00/MF $1.00

Details and results are presented of a study concerned with secondary electron emission from porous tungsten surfaces. This study was conducted to determine the mechanisms of beam enhancement in an ion rocket thrust augmentor. Graphs are given of the results, and show that the energy distribution of the secondary electrons is limited to the so-called "true" secondaries of energies ≤ 50 eV. The secondary maxima is highly localized around the $0 \leq \epsilon_{max} < 10$ V region and is independent of the primary potential over a wide range. This highly substantiates an original assumption that secondary electron emission is a bulk property of the material and not as a general rule a property of surface states. C.T.C.

N66-36824# Aerospace Corp., El Segundo, Calif.
TRI-DIMENSIONAL PLASMA COMPRESSION ASSEMBLIES
V. Josephson Dec. 1965 17 p refs
(Contract AF 04(695)-669)
(TDR-669(6550-10)-2; SSD-TR-66-108; AD-635779) CFSTI: HC $1.00/MF $0.50

Two configurations for achieving tri-dimensional plasma compression were designed, and preliminary testing was accomplished on one. The results indicate that the configuration does produce very high plasma temperatures as a result of the compression; this is evidenced by the sharp ($<1\mu$sec), intense ($>10^8$) burst of neutrons resulting from the compression and heating of a deuterium plasma to fusion temperatures. Author (TAB)

N66-36849*# Stanford Research Inst., Menlo Park, Calif.
STUDY OF THE EFFECTS OF A PLASMA IN THE NEAR-ZONE FIELD OF AN ANTENNA
W. C. Taylor Washington, NASA, Sep. 1966 40 p refs
(Contract NAS1-4973)
(NASA-CR-611) CFSTI: HC $2.00/MF $0.50 CSCL 20I

A program of measurements is reported showing the effects on an antenna caused by a plasma in the near field. The measurements were performed with X-band apertures in ground planes exposed to plasmas in a 12-inch shock tube and in an RF-heated plasma jet. The effects of plasma on the antenna reflection coefficient were measured in a series of shock-tube firings at two different collision frequencies. In the plasma jet, where the plasma layer over the antenna was thin compared with a wavelength, both reflection coefficient and total impedance were measured. Patterns were measured in the plasma jet over a large range of electron density. In addition it was demonstrated that an over-dense plasma layer in the near field reduces the far-field radiation level by at least 10 dB more than the same layer located just outside the near field. All these measurements show that the small boundary region near the ground plane, where electron density falls essentially to zero, significantly influences the plasma effects compared with predictions based on a uniform plasma. Author

N66-36869# Joint Inst. for Lab. Astrophysics, Boulder, Colo.
THE LOWERING OF THE IONIZATION POTENTIAL AND RELATED PROBLEMS OF THE EQUILIBRIUM PLASMA
J. Cooper, ed. 15 Jul. 1966 180 p refs Proc. of Workshop Conf. Held Colorado Univ., 12–13 Nov. 1965
(Contract DA-31-124-ARO(D)-139; Proj. Defender)
(JILA-79; AD-486077)

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N66-36870# Bochum Univ. (Germany).
PROBLEMS OF THE PLASMA IN EQUILIBRIUM
G. Ecker and W. Kroell *In* Joint Inst. for Lab. Astrophys. The Lowering of the Ionization Potential and Related Probl. of the Equilibrium Plasma 15 Jul. 1966 p 7–47 refs (See N66-36869 22-25)

The plasma in thermodynamic equilibrium has been extensively discussed on the basis of the assumption that all particles can be classified as "bound" or "free." Under this assumption simple models led to divergencies of the partition functions of bound and free particles as well as to discrepancies of the predicted level shift and lowering of the ionization potential. On the basis of a quantum-mechanical treatment we develop a "free-bound-approximation" for the eigenstates and a classical approximation for the partition function. It is a decisive feature of the analysis that it takes free-bound interaction into account. The results remove the divergence difficulties and produce values for the "lowering of the ionization potential" and the limit of the "series-continuum." Author

N66-36871# Howard Univ., Washington, D. C. Dept. of Physics.
STATISTICAL MECHANICS OF A PARTIALLY IONIZED PLASMA
J. L. Jackson and L. S. Klein *In* Joint Inst. for Lab. Astrophys. The Lowering of the Ionization Potential and Related Probl. of the Equilibrium Plasma 15 Jul. 1966 p 49–54 refs (See N66-36869 22-25)

Work on the statistical mechanics of a partially ionized plasma attempted to incorporate a quantum mechanical treatment of the atomic states in a manner consistent with the usual Debye–Huckel approximation for fully ionized plasmas. It is felt that only on the basis of a fundamental theory can various theoretical discussions of the lowering of the ionization potential be examined critically. The particular form of statistical mechanical theory applied is the "distribution of potential method." This method appears to be singularly useful for the evaluation of the chemical potentials of the different constituents of a partially ionized plasma. Author

N66-36872# Institute for Defense Analyses, Arlington, Va.
EFFECTIVE DISSOCIATION AND IONIZATION ENERGIES IN PARTLY IONIZED AND DISSOCIATED GASES
Adolf R. Hochstim *In* Joint Inst. for Lab. Astrophys. The Lowering of the Ionization Potential and Related Probl. of the Equilibrium Plasma 15 Jul. 1966 p 55–78 refs (See N66-36869 22-25)

Theoretical calculations on thermodynamic properties of air were performed by using terms of higher order than the Debye from charge-charge interactions to obtain the effective ionization energy of single ionized atoms in a moderately-dense weakly-ionized gas. Contributions from neutral-neutral interactions were extented to encompass those from ion-neutral interactions, and electron-neutral interactions were obtained by quantum mechanics from scattering phase shifts and their relations to the virial coefficient. G.G.

N66-36873# California Univ., Livermore. Lawrence Radiation Lab.
REVIEW OF CURRENT KNOWLEDGE OF EQUILIBRIUM PLASMA STATISTICAL MECHANICS
Hugh De Witt *In* Joint Inst. for Lab. Astrophys. The Lowering of the Ionization Potential and Related Probl. of the Equilibrium Plasma 15 Jul. 1966 p 87–107 refs (See N66-36869 22-25)

Statistical mechanics in systematic and rigorous calculations on equilibrium plasma thermodynamics were reviewed. Analytical calculations were performed on the following plasma compositions: an electron gas as a one component plasma; a fully ionized two component plasma; and a lower temperature and higher density partially degenerated plasma. An attempt was made to calculate the thermodynamic properties of a plasma even when a considerable fraction of the electrons were bound, by starting from electron and point nuclei through a diagrammatic expansion of the two component partition function to refined cluster formations. G.G.

N66-36874# General Dynamics Corp., San Diego, Calif. John Jay Hopkins Lab. for Pure and Applied Science.
THOMAS–FERMI METHODS IN THE DESCRIPTION OF THE PLASMA IN EQUILIBRIUM
John C. Stewart and Kedar D. Pyatt, Jr. *In* Joint Inst. for Lab. Astrophys. The lowering of the Ionization Potential and Related Probl. of the Equilibrium Plasma 15 Jul. 1966 p 109–130 refs (See N66-36869 22-25)

The average electrostatic potential near a nucleus immersed in a plasma is evaluated using a finite-temperature Thomas–Fermi model. The part of this potential directly attributable to the presence of the plasma is isolated and is used to evaluate the reduction in ionization potential for a wide range of parameters. A simple analytic solution, exhibiting Debye–Hückel and ion-sphere limits, is also obtained and is used as an interpolatory device. Author

N66-36875# International Business Machines Corp., Palo Alto, Calif. Systems Research and Development Center.
JUSTIFICATIONS OF THE STEWART–PYATT MODEL
B. H. Armstrong *In* Joint Inst. for Lab. Astrophys. The Lowering of the Ionization Potential and Related Probl. of the Equilibrium Plasma 15 Jul. 1966 p 131–136 refs (See N66-36869 22-25)

Given are justifications for a plasma model, which produces the e^2/D term (D=Debye length) at low density and an e^2/r_0 term (r_0=interparticle spacing) at high density. Projected is a plasma containing atoms, ions, free electrons, and a single photon where the frequency is adjusted so that one of the originally neutral atoms is ionized, and where the energy of the neutral atom is an isolated value. After the photon is absorbed, the total energy of the system is the new energy of the plasma and the energy of the ion which has been formed by the photoionoization. G.G.

N66-36876# Comitato Nazionale per l'Energia Nucleare, Frascati (Italy).
VERY DENSE PLASMAS IN THE THOMAS–FERMI STATISTICAL MODEL
G. Lehner *In* Joint Inst. for Lab. Astrophys. The Lowering of the Ionization Potential and Related Probl. of the Equilibrium Plasma 15 Jul. 1966 p 137–149 refs (See N66-36869 22-25)

For very high pressures the degree of ionization of a plasma cannot be calculated from the Saha-equation, instead we shall use the Thomas–Fermi statistical model of the atom. This model yields the energy distribution of electrons in a self consistent potential surrounding the nucleus and one calculates the number of free electrons having sufficient energy to overcome the potential barrier at the surface of the atom. Two cases are discussed: (a) the simple Thomas–Fermi model for zero temperature, (b) its generalization to nonzero temperature. Author

N66-36877# Maryland Univ., College Park.
THERMAL IONIZATION EQUILIBRIUM IN HYDROGEN PLASMAS
H. R. Griem *In* Joint Inst. for Lab. Astrophys. The Lowering of the Ionization Potential and Related Probl. of the Equilibrium Plasma Jul. 1966 p 151–157 (See N66-36869 22-25)

Possible experiments to obtain corrections to the Saha equation for the case of a hydrogen ionization plasma are discussed. In order to obtain accurate measurements on the lowered ionization potential, its effects on the ground state potential should be substantially larger than 20%. Modification of the Saha equation and electron density measurements with respect to the density of some excited state enlarge the criteria and lower the measurement error probability to less than 4%; thus, the use of low excited states makes it possible to measure the lowering of the plasma ionization potential sufficiently to discriminate against corrections which are much larger than the Debye result. G.G.

N66-36878# Imperial Coll. of Science and Technology, London (England).
THE PLASMA IN EQUILIBRIUM: EXPERIMENTAL ASPECTS
W. R. S. Garton *In* Joint Inst. for Lab. Astrophys. The Lowering of the Ionization Potential and Related Probl. of the Equilibrium Plasma Jul. 1966 p 159–172 (See N66-36869 22-25)

Spectral transitions and H-like series of alkalis were measured for improved ionization potential values and the quantum-defect plot for the principle series of Sr I is shown. It was found that the ^2S series gave a Ritzian plot whereas the 2D series showed a marked downward curvature towards the limit due to a perturbation from the $sp_2\,^2D$ term inside the ionization continuum. The spectrum of La I revealed a previously unknown series which was identified as $s^2d^2D-s^2p\,2P$, the members of which showed autoinonization broadening with a correction of about 315 cm^{-1} to the previously accepted value. Some experiments on the depression of the ionization potential by absorption through shock heated metal vapor were also briefly outlined. G.G.

N66-36879# Northrop Space Labs., Hawthorne, Calif.
A COMPARISON OF EXPERIMENTAL AND THEORETICAL RESULTS FOR THE LOWERING OF THE IONIZATION POTENTIAL IN AN EQUILIBRIUM PLASMA
H.N. Olsen *In* Joint Inst. for Lab. Astrophys. The Lowering of the Ionization Potential and Related Probl. of the Equilibrium Plasma 15 Jul. 1966 p 173–180 refs (See N66-38869 22-25)

A technique is presented for judging the theoretical conclusions regarding methods to be applied in correcting the computed plasma compositions. It involves the determination of transition probabilities from measured emission coefficients of a prominent pair of argon lines defined as reference lines (λ 6965 Ar(I) and λ 4806 Ar(II). The measured emission coefficients of the reference lines emitted by the 1.1 atm argon plasma are plotted; parametric equations are given to represent the plot. If the transition probabilities are normalized to unity, a similar plot of the normalized emission coefficients is obtained, and the results of three different methods for correcting the composition for lowering of the ionization potential are shown. An equation is formulated to summarize the results of theoretical discussions, and criteria for determining the numerical constants in this equation are discussed. Tabulated data are given to compare theoretical and independently measured experimental values. It is pointed out that before any definite conclusions can be reached, it is essential that improved theoretical values for the ion transition probabilities be computed. M.G.J.

N66-36880# Imperial Coll. of Science and Technology, London (England).
A PROPOSED EXPERIMENT TO STUDY THE DEPRESSION OF THE IONIZATION POTENTIAL IN A PLASMA
D. D. Burgess, W. H. Parkinson, and E. M. Reeves (Harvard Coll. Obs.) *In* Joint Inst. for Lab. Astrophys. The Lowering of the Ionization Potential and Related Probl. of the Equilibrium Plasma Jul. 1966 p 181–187 refs (See N66-36869 22-25)

The advantages of using pressure driven shock tubes for measuring ionization potential depressions are assessed, and it is pointed out that the parameters of the plasma produced make it possible to use highly accurate techniques that are practically free of systematic errors. The possibility of varying the electron density in the plasma over a wide range while keeping the temperature relatively constant is also cited as an advantage. The use of cesium is proposed as the dominant impurity; by varying the amounts added, the electron density can be varied over a wide range—probably between 5×10^{15}cm^3 and 10^{17}cm^{-3}. The cesium ionization will not be studied; instead, a small percentage of calcium will be added in an attempt to measure directly the temperature, electron density, and the neutral and ionized calcium particle densities, and thereby study the appropriate Saha equation. Experimental procedures are detailed. It is pointed out that the only errors of consequence are purely ramdom and, at least in principle, could be reduced to within arbitrarily small limits. M.G.J.

N66-36881# Joint Inst. For Lab. Astrophysics, Boulder, Colo.
PROPOSAL FOR AN INVESTIGATION OF HIGHLY EXCITED STATES IN A DISCHARGE BY MEANS OF A TUNABLE LASER BEAM
B. Brehm *In its* The Lowering of the Ionization Potential and Related Probl. of the Equilibrium Plasma 15 Jul. 1966 p 189-191 refs (See N66-36869 22-25)

As the energy range over which a laser can be tuned is very small, modulation by microwaves is considered to offer the most promising approach. It is pointed out that the limited size of the tuning range makes it necessary to match the laser transition to the discharge material. Assuming that a shift of 10^{-4}eV can be accomplished, the published gas laser lines were compared with atomic transitions. Three cases are proposed for investigating the influence of fields on highly excited states of atoms. It is expected that new laser lines will increase the number of atoms which can be excited to states close to their ionization limit. M.G.J.

N66-36882# Harvard Univ., Cambridge, Mass.
BIBLIOGRAPHY OF RESEARCH ON LOWERING OF IONIZATION POTENTIALS IN PLASMAS (APPENDIX)
S. G. Brush and B. H. Armstrong (IBM, Palo Alto, Calif.) *In* Joint Inst. for Lab. Astrophys. The Lowering of the Ionization Potential and Related Probl. of the Equilibrium Plasma 15 Jul. 1966 21p refs (See N66-36869 22-25)

An annotated bibliography is presented on the theory and experiment regarding the effect of interactions with other particles on the ionization potential of an atom. The reports are grouped according to partition function cutoff, calculations using partition function cutoffs, and effective ionization potential in a plasma. M.G.J.

N66-37000# United Kingdom Atomic Energy Authority, Culham (England).
SOME PROBLEMS OF THE DEVELOPMENT OF MODERN PHYSICS. REPORT ON THE ACTIVITIES OF THE DEPARTMENT OF GENERAL AND APPLIED PHYSICS
L. A. Artsimovich May 1965 19 p Transl. into English from Vestn. Akad. Nauk SSR (Moscow), no. 2, 1965 p 1–15
(NP-TR-1291; CTO-200)

In reviewing the requirements of a thermonuclear plasma, it is pointed out that the plasma should be completely ionized with electron and ion temperatures of 10^8 to10^9 degrees. At present theory is leading experiment. Theory indicates that quasineutrality must be maintained, that is, there should be a mutual compensation of the ion and electron space charges. It is noted that collisions can be ignored at thermonuclear temperatures (the effective cross section for coulombic interaction decreases to 10^{-23}cm^2 at 10^9 degrees). The electrical conductivity of a high-temperature plasma increases rapidly with temperature, and exceeds the electrical conductivity of a typical metal by a factor of several hundred at 10^9 degrees. A magnetic trap using the pinch effect or magnetic mirrors is used to confine the hot plasma. The instability problem is foremost in plasma physics. Theory shows that if the strength of an applied longitudinal magnetic field is sufficiently great, conditions are ripe for overcoming the most dangerous, large-scale instabilities pecular to a conducting plasma. Small-scale instabilities must be also avoided. Plasma loops (toroidal) with electron and ion temperatures of a few million degrees have been attained at a particle concentration of 10^{13}/cm^3. The lifetime of the plasma particles is a few milliseconds. Various methods of heating the plasma have been proposed (external injection, turbulent heating of plasma, etc), but at present attention is focused on creating conditions to attain a stable confinement of the hot plasma in the trap. By creating a magnetic field which increases on all sides, plasma confinement in a limited space has been proved at a particle concentration of 10^{10}/cm^3. The density must be raised to $10^{13}-10^{14}$ particles/cm^3 in order to consider the problem as solved. Many new kinds of instabilities are being discovered each month. It is pointed out that fast particles with a non-Maxwellian distribution are continuously generated in an unstable plasma. It will be difficult to produce a plasma without these fast particles. NSA

N66-37012# United Kingdom Atomic Energy Authority, Harwell (England). Research Group.
THE PLASMA BURNER AND ITS USE FOR FUSING VARIOUS MATERIALS INTO GLOBULES
A. Strigl and H. Bildstein Aug. 1965 25 p refs Transl. into ENGLISH of Oesterr. Studiengesellschaft fuer Atomenergie Rept. SGAE-CH-12/1964
(NP-TR-1347; SGAE-CH-12/1964)

A plasma melting installation was described that is suitable for the preparation of round fused particles from metals, oxides, and carbides. The various factors affecting the fusability were discussed, and results on melt studies were reported. Author (NSA)

N66-37064*# Air Force Cambridge Research Labs., Bedford, Mass. Microwave Physics Lab.

NONLINEAR ELECTROMAGNETIC WAVE PROPAGATION IN PLASMAS

Robert J. Papa May 1966 37 p refs *Its* Phys. Sci. Res. Paper No. 230

(AFCRL-66-347; AD-635874) CFSTI: HC $2.00/MF $0.50

A review is presented of the current literature pertaining to high power RF field-plasma interactions. In the survey, the class of nonlinear interactions is restricted to the case where the effective dielectric constant of the plasma is a function of the local electric field intensity. Since the propagation characteristics of an EM wave depend upon the effective dielectric constant, the presence of an intense RF field can modify the propagation characteristics of an EM wave. The assumptions and basic theoretical approach of each author are discussed and the most significant results are summarized. The approaches used by different authors are compared. A critique is made of the various approaches and their advantages and limitations are pointed out. Author (TAB)

N66-37098# Air Force Cambridge Research Labs., Bedford, Mass. Microwave Physics Lab.

WAVE PROPAGATION IN A NON-MAXWELLIAN, MAGNETOACTIVE, NONLINEAR PLASMA

Robert J. Papa and Richard E. Haskell May 1966 50 p refs *Its* Phys. Sci. Res. Papers No. 233

(AFCRL-66-372; AD-636096) CFSTI: HC $2.00/MF $0.50

Expressions for the components of a nonlinear ac conductivity tensor have been derived—corresponding to a temperate, weakly ionized, lossy magnetoplasma. The electrical conductivity tensor is nonlinear because its components are functions of the isotropic part of the electron velocity distribution function f^o, where f^o depends upon the amplitude and polarization of the local rf field by diagonalizing the conductivity tensor and referring Maxwell's field equations to the principal co-ordinate directions, it is shown that an elliptically polarized em wave normally incident upon an inhomogeneous magnetoplasma slab will launch only a right-hand and left-hand wave into the plasma if both the dc magnetic field and the electron density gradients are perpendicular to the interfaces. The net reflection transmission-coefficients for left-hand and right-hand modes are computed using a Runge-Kutta numerical integration procedure. For low power levels, the right-hand and left-hand waves propagate independently of one another. For high field intensities, the propagation of the right-hand mode depends upon the amplitude of the left-hand mode, and vice versa. Reflection and transmission coefficients are presented as a function of normalized plasma parameters. Author (TAB)

N66-37206*# State Univ. of Iowa, Iowa City. Dept. of Physics and Astronomy.

NUMERICAL STUDIES OF THE NON-LINEAR VLASOV EQUATION

Thomas P. Armstrong (Ph.D. Thesis) Aug. 1966 155 p refs *Its* Rept.-66-34

(Grant NsG-233-62)

(NASA-CR-78021) CFSTI: HC $5.00/MF $1.00 CSCL 20I

The numerical integration of the initial value problem for the nonlinear Vlasov equation is studied. The Vlasov equation is used to describe the dynamics of a collisionless one-dimensional classical electron gas confined between two perfectly reflecting boundaries. Only long range Coulomb interactions of the electrons are considered. The numerical results obtained for nonlinear Landau damping compare well with Knorr's results. The results on stable initial conditions show that as the degree of non-linearity of the initial conditions is increased, the deviation from linear Landau damping appears sooner and is more severe. In some cases damping was observed to cease. Curves showing the time dependence of the damping decrement are derived and compared with predictions of nonlinear theories. New results obtained include the observation that for strongly nonlinear cases, the damping of the electric field causes an initially Maxwellian f_o (v, 0) to develop a peak in the neighborhood of the phase velcity; strong growth of the second harmonic is seen after f_o (v, t) develops such a peak. Also new is the interpretation of the development of a certain class of strongly unstable initial conditions as approaching an inhomogeneous equilibrium. Author

N66-37298*# National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.

STUDY OF COAXIAL HALL CURRENT ACCELERATORS AT MODERATE PRESSURES

H. A. Hassan (N. C. State Univ.), Robert V. Hess, and William Grossmann, Jr. Washington, NASA, Oct. 1966 36 p refs

(129-01-05-04-23)

(NASA-TN-D-3286) CFSTI: HC $2.00/MF $0.50 CSCL 20I

A study of coaxial Hall current accelerators at moderate pressures (of the order of 10 mm Hg) and moderate mass flow rates (of the order of 1 g/sec) is presented. The analysis is based on the conservation equations of the plasma constituents and employs a Saha equation with the gas temperature replaced by the electron temperature. The arc voltage is shown to be a linear function of the applied magnetic field strength at constant total current; also, a voltage plateau is reached at the higher currents for a constant magnetic field strength. In addition, for a given total current, magnetic field strength, pressure, and mass flow rate, the theory predicts the electron, ion, and neutral temperatures; degree of ionization; Hall current; and axial and azimuthal mean velocities. Comparison of theory with experiment shows that the theoretical model is in fair agreement with experiment. The influence of ionization rates and three-dimensional effects is discussed. Author

N66-37317*# Maryland Univ., College Park.

ELECTRON IMPACT BROADENING OF ISOLATED ION LINES

Hans R. Griem [1966] 14 p refs

(Grant NGR-21-002-073)

(NASA-CR-78201) CFSTI: HC $1.00/MF $0.50 CSCL 20H

Previous experiments have yielded Stark widths of spectral lines from singly ionized atoms other than helium which exceed theoretically predicted values by factors from 2 to 10. Equations are presented to show that these discrepancies stem from the neglect of collision-induced transitions between upper and lower levels of the line and of Coulomb interactions with the perturbed ions. S.P.

N66-37319*# Maryland Univ., College Park.

CORRECTIONS TO THE ASYMPTOTIC HOLTSMARK FORMULA FOR HYDROGEN LINES BROADENED BY ELECTRONS AND IONS IN A PLASMA

Hans R. Griem [1966] 26 p refs

(Grant NGR-21-002-073)

(NASA-CR-78198) CFSTI: HC $2.00/MF $0.50 CSCL 20I

Expressions are given for the electron contribution to the Stark broadening at large distances from the line center, referred to the quasi-static broadening by ions. The electron contribution is calculated with the impact approximation using Lewis or Debye cutoffs, or with the quasi-static approximation. In addition to monopole-dipole interactions causing perturbations within the group of levels having the principal quantum number of the upper state of the line, some allowance is made for monopole-quadrupole interactions, for collision-induced transitions involving changes of principal quantum numbers, and for perturbations of the lower state of the line. Using improved estimates for the relevant atomic

matrix elements, the correction factor to the asymptotic Holtsmark result for ion broadening is calculated to an estimated accuracy of 10% for almost all lines of the early hydrogen line series, and estimates are given for higher order terms in the asymptotic expansion and Debye shielding effects. The electron broadening is significant under all practical conditions, even in the validity regime of the impact approximation. Author

N66-37326# Stanford Univ., Calif. Inst. for Plasma Research.
REPORT ON BAGEL II PROGRESS Status Report No. 14, 1 Aug. 1965 - 30 Apr. 1966
O. Buneman Apr. 1966 17 p refs
(Contract AT(04-3)-326)
(TID-23025) CFSTI: HC $1.00/MF $0.50

In a pulsed-toroidal discharge the observed drift and diffusion rates in a uniform magnetic field of several hundred gauss and densities $\sim 10^{13}$ were reduced using the bumpy torus principle. Further, by examining the discharge during continuous operation (but at a density $\sim 10^{10}$–10^{11}) a flute instability with k=0 was found and suppressed in the bumpy field. The suppression of the instability is believed to cause the lowered diffusion rate. The role of the flute instability in the particle loss mechanism, described qualitatively, should be put on a firmer experimental basis by extensive quantitative analysis. Author (NSA)

N66-37375*# Stanford Univ., Calif. Inst. for Plasma Research.
THE PLASMA CAPACITOR IN A MAGNETIC FIELD
F. W. Crawford, T. D. Mantei, and J. A. Tataronis Apr. 1966 27 p refs
(Grant NGR-05-020-077; NSF GK-617)
(NASA-CR-78164; SU-IPR-64) CFSTI: HC $2.00/MF $0.50 CSCL 20I

This paper extends previous work on the impedance of a parallel plate capacitor, filled with warm plasma, to take account of a static magnetic field. Computations are presented for parallel plate and coaxial cylinder geometries, and indicate series of resonances occurring at, and between, the electron cyclotron frequency harmonics. It is suggested that if the theoretical results were confirmed experimentally, plasma admittance measurements would form the basis of a simple and powerful diagnostic technique for measuring plasma parameters such as electron density and temperature in the laboratory and in the ionosphere. Author

N66-37483# Institut d'Aeronomie Spatiale de Belgique, Brussels.
NOTIONS OF PLASMA PHYSICS [BEGRIPPEN OVER PLASMA FYSICA]
E. Aerts 1965 38 p refs In DUTCH; ENGLISH, FRENCH and GERMAN Summaries presented at Inst. of Theoret. Phys. of the Catholic Univ. of Nijmegen, Netherlands, 14 Dec. 1965
(A-40-1965) CFSTI: HC $2.00/MF $0.50

After defining a plasma, the different aspects of the latter are reviewed. Recent ideas about cosmic plasmas are reported and also some important practical applications of plasma physics. Fundamental notions such as plasma frequency, magnetic pressure and Alfven speed are deduced from the intrinsic properties of plasmas. An important part of this text is devoted to the behavior of plasmas in a magnetic field both from a microscopic and macroscopic view point. A review of the technological applications in magnetohydrodynamics is given. Author (ESRO)

N66-37484# Kernforschungsanlage, Juelich (West Germany). Institut fuer Plasmaphysik.
BREAKDOWN OF AN ELECTRODELESS RING DISCHARGE AND THE DEVELOPMENT OF THE ELECTRON DENSITY AND TEMPERATURE IN A SPINDLE CUSP
H. J. Belitz and E. Kugler Jan. 1966 13 p refs
(JUL-352-PP) CFSTI: HC $1.00/MF $0.50

The magnetic field, electron temperature and density of a hydrogen plasma, generated by discharging a 0.5/uF, 25kV condenser to a pair of conical coils producing a cusp shaped magnetic field, have been measured space and time resolved. Electron densities of 10^{16}–$10^{17}cm^{-3}$ and electron temperature of 1.5–3 eV were obtained from Stark broadening of H_β from the absolute intensity of the continuum and from the relative intensity of H_β/continuum respectively. By combining the results with magnetic probe measurements a consistent picture of the plasma can be proposed. Author (ESRO)

N66-37503# Kernforschungsanlage, Juelich (West Germany). Institut fuer Plasmaphysik.
MEASUREMENTS OF MAGNETIC PROBES DURING THE PREHEATING PHASE OF A SPINDLE CUSP EXPERIMENT [MAGNETISCHE SONDENMESSUNGEN WAEHREND DER VORHEIZPHASE EINES SPINDLE-CUSP-EXPERIMENTES]
H.-J. Belitz and E. Kugler Aug. 1965 18 p In GERMAN Presented at Meeting of the Comm. for Phys. of Discharge in Plasma and Gases of the Deut. Physik. Ges., Munich, 27–30 April 1965
(JUL-281-PP) CFSTI: HC $1.00/MF $0.50

The preheating of the plasma in the spindle cusp experiment of the nuclear research facility is effected by fast condenser discharge (0.15 kj, 800 kHz) over the compression coils. The radial and axial components as well as the quality of the magnetic field were measured at different points of the discharge tube by means of coil probes. These measurements show the moment of ignition and the trapping of the magnetic field through the plasma. Several layers are formed with respectively opposite field direction which dissolve only slowly. Author (ESRO)

N66-37505# Kernforschungsanlage, Juelich (West Germany). Institut fuer Plasmaphysik.
PLASMA EFFECTS ON AN IONIZED HELIUM LINE [PLASMAEFFEKTE AN EINER IONISIERTEN HELIUMLINIE]
H. F. Berg Aug. 1965 29 p refs In GERMAN; ENGLISH Summary Presented at Meeting of the Plasma Phys. Comm. of the Deut. Physik. Ges., Munich, 1965
(JUL-280-PP) CFSTI: HC $2.00/MF $0.50

Theoretical calculations by L. P. Kudrin and G. V. Sholin propose a density-dependent blue-shift of the λ4686 He II line due to quadrupole interaction of the radiating ion with the plasma. H. R. Griem also estimates a blue shift of the same order of magnitude due to plasma polarization, which is both density and temperature-dependent. In an attempt to make a precision measurement of this effect under various plasma conditions no shift could be found within the experimental accuracy of V0.3 A. A T-tube served as a plasma source and the profiles were obtained in single shots employing a multichannel light guide apparatus. An erroneous measurement by H. F. Berg et al., previously published, is discussed. Author (ESRO)

N66-37527*# General Electric Co., Philadelphia, Pa. Missile and Space Div.
TRANSPORT PROPERTIES OF PARTIALLY IONIZED NITROGEN. II: METHOD AND RESULTS
Martin P. Sherman Aug. 1965 53 p refs
(Contract NASr-32)
(NASA-CR-78376; R655D44) CFSTI: HC $3.00/MF $0.50
CSCL 20I

The transport properties of nitrogen up to 15,000°K are obtained. The nitrogen is assumed to consist of five species; electrons, molecular, ground state atomic, electronically excited atomic, and singly ionized atomic nitrogen. In this work the method of calculation and the results are presented. In part I (1) the collision integrals used in the calculation were presented. Author

N66-37528*# General Electric Co., Philadelphia, Pa. Missile and Space Div.

TRANSPORT PROPERTIES OF PARTIALLY IONIZED NITROGEN I: THE COLLISION INTEGRALS

Martin P. Sherman Jul. 1965 54 p refs

(Contract NASr-32)

(NASA-CR-78375; R655D43) CFSTI: HC $3.00/MF $0.50 CSCL 20I

This report is the first of two concerned with the computation of the transport properties of nitrogen up to temperatures where there is single ionization. In this report the collision integrals are obtained using the best available information. In particular, use is made of the recent work of Knof, Mason, and Vanderslice for the charge exchange cross section of the $N-N^+$ interaction. Calculations were performed to obtain the $\Omega^{(2,2)}$ collision integral for the $N-N^+$ interaction. In a second report, transport properties will be computed by a new method which permits rapid calculation of the transport properties of multicomponent mixtures valid up to the second approximation of the variational scheme of Hirschfelder, et. al. Author

N66-37594# United Kingdom Atomic Energy Authority, Harwell (England). Electronics and Applied Physics Div.

OVERALL THERMAL EFFICIENCIES OF COMBINED GAS-STEAM CYCLES IN AN M. H. D-REACTOR SYSTEM

M. J. Parsons and G. Rice Jun. 1966 43 p refs

(AERE-R-5031) HMSO: 5s 6d

The efficiency of a combined reactor - M. H.D. - steam plant was established for various values of reactor outlet temperature, M.H.D. duct inlet and outlet temperatures and steam generator inlet and outlet temperatures. The system considered used argon or helium as the working fluid for the reactor and M.H.D. duct. Potassium seeding was added for the M.H.D. duct and non-thermal ionization was assumed to occur. A range of steam conditions was considered up to 3500 p.s.i. and 1050°F superheat and reheat. The sizes of the major components were also compared for a suitable range of gas pressures. The study of efficiencies showed that the gas topper cycle and the steam cycle must always be considered together because of their interdependence in the heat exchanger. Not to do this leads to serious over-estimates of the gains possible with a topping cycle. For example, it was found that a steam cycle thermal efficiency of 52% could be improved to only 56% when all thermodynamic considerations were taken into account, whereas ignoring these would have led to a figure of 63% under the same conditions. Author

26 PHYSICS, SOLID-STATE

Includes semiconductor theory; and superconductivity. For applications see: 16 Masers. For related information see also: 10 Electronics.

N66-36664# United Kingdom Atomic Energy Authority, Harwell (England). Metallurgy Div.

DISLOCATIONS MOVEMENT THROUGH RANDOM ARRAYS OF OBSTACLES

A. J. E. Foreman and M. V. Makin Jun. 1966 17 p refs

(AERE-R-5201) CFSTI: HC $1.00/MF $0.50

The detailed movement of a dislocation line through a random array of point obstacles in the glide plane has been examined, using a digital computer, on the basis of the line tension approximation. The breakaway criterion at each obstacle is a critical angle between the arms of the dislocation, corresponding to a critical force on the obstacle. The shear stress required to move the dislocation through the array has been determined for the breaking angles 0 to π and the result expressed in an empirical form. The dislocation is observed to often move by an unzipping mechanism involving consecutive breakaway from obstacles. For weak obstacles the critical shear stress is appreciably less than for a regular array of the same density and corresponds exactly with the Friedel relation for the spacing of obstacles. For strong obstacles the dislocation motion is characterized by encircling movements and the severance of many closed loops, and the critical shear stress rises to a value of 0.81 $\mu b/L$ where L is the average spacing. Thermal fluctuations are taken into account, and the temperature dependence of the critical shear stress for point defect hardening is calculated. Author

N66-36802# Army Missile Command, Huntsville, Ala. Physical Sciences Lab.

INVESTIGATION OF EXCHANGE EFFECTS IN RUBY BY LINE SHAPE COMPARISONS

Richard L. Hartman, Harry C. Meyer, Jefferson S. Bennett, and Alfred C. Daniel [1965] 16 p refs

(AD-634688) CFSTI: HC $1.00/MF $0.50

A report is given on studies involving the line shapes obtained by ultrasonic paramagnetic resonance and by electron paramagnetic resonance methods in ruby at 4.2K and having a Cr(3+) concentration ranging from 0.05% to 1.2%. TAB

N66-36822# Polytechnic Inst. of Brooklyn, N. Y.

COMPOUNDS WITH DEFECT STRUCTURES Progress Report No. 5, 1 Oct. 1965–31 Mar. 1966

E. Banks, M. Goldblatt, E. Kostiner, V. Abbruscato, and N. Tashima [1966] 12 p refs

(Contract DA-31-124-ARO(D)-71)

(AD-635653) CFSTI: HC $1.00/MF $0.50

Crystals in the system $Mn_{2-x}Fe_xO_3$ ($0<x<1$) and $Mn_{1.8}Al_{0.2}O_3$ were grown by anodic electrolysis from tungstate melts. Their reciprocal susceptibility-temperature curves show apparent antiferromagnetic behavior and large negative Weiss constants. A number of fluxes were tried in the effort to obtain large crystals of fluoride-substituted copper ferrite, with the production of small crystals of spinel structure, some of which are tetragonal, and others cubic. Least-squares refinement of the structure of the spodiosite Ca_2PO_4Cl to an R value of 0.043 has led to atomic positions accurate to ± 0.001A for the heavy atoms and ± 0.002A for the oxygens. Further studies of the absorption spectrum of Yb_3 in CdF_2 were made for the purpose of understanding the appearance of an absorption peak at 977 nm, which disappears as interstitial fluoride ions are replaced by Na^+ as the charge compensator. This peak does not appear in CaF_2-Yb^{3+}, but is present in CdF_2 and PbF_2. Author

N66-36868# Illinois Univ., Urbana. Dept. of Electrical Engineering.

JUNCTION EFFECTS IN COMPOUND SEMICONDUCTORS

N. Holonyak, Jr., M. D. Sirkis, C. J. Nuese, J. S. Moore, and G. Stillman Feb. 1966 12 p refs

(Contract AF 19(628)-4337)

(AFCRL-66-245; AD-635620) CFSTI: HC $1.00/MF $0.50

The current state of progress in the synthesis, junction fabrication, and lamp and laser operation of $Ga(As_{1-x}P_x)$ is described. The effect of the considerable depth of donor states near the indirect <100> conduction band minimum is shown to reduce the high-energy limit (reduces x) of laser operation in $Ga(As_{1-x}P_x)$. Silicon p-i-n deep-level oscillators are described that operate beyond 100 MHz under dc bias.

Author (TAB)

N66-36922# Fairchild Semiconductor Corp., Mountain View, Calif.

RADIATION STUDY ON MOS STRUCTURES Scientific Report No. 1, Dec. 15, 1965–May 15, 1966

E. H. Snow and A. S. Grove Jun. 1966 29 p refs

(Contract AF 19(628)-5747)

(AFCRL-66-449; AD-636163) CFSTI: HC $2.00/MF $0.50

Ionizing radiation causes the buildup of a positive space-charge within the oxide on an MOS structure. The location of this space-charge and the kinetics of its formation and annealing have been studied experimentally. On the basis of these experiments, a simple model has been proposed which relates this space-charge to the defect structure of the oxide and provides results in good agreement with the data. Photocurrents flowing in the oxide due to X-rays and ultraviolet light have been used in the interpretation of the experiments and have made possible the construction of detailed energy band diagrams of the MOS structure. Author (TAB)

N66-36947# Oak Ridge National Lab., Tenn.
METHODS FOR CALCULATION OF THE ELECTRONIC STRUCTURE OF DEFECTS IN INSULATORS
U. Oepik and R. F. Wood Apr. 1966 11 p refs From Conf. on the Calculation of the Properties of Vacancies and Interstitials, Skyland, Va.
(Contract W-7405-ENG-26)
(ORNL-P-2193; CONF-660529-1) CFSTI: HC $1.00/MF $0.50

Calculational techniques for determining the electronic structure of the F center in alkali halides are described. NSA

N66-36948# Oak Ridge National Lab., Tenn.
A CALCULATION OF FORCE-CONSTANT CHANGES FOR THE U CENTER
R. F. Wood and R. L. Gilbert Apr. 1966 11 p refs From Conf. on the Properties of Vacancies and Interstitials, Skyland, Va.
(Contract W-7405-ENG-26)
(ORNL-P-2194; CONF-660529-2) CFSTI: HC $1.00/MF $0.50

Calculations were made of both the optical and infrared properties of U centers in KCl, KBr, and KI. The preliminary results are discussed. NSA

N66-36990# Oakridge National Lab., Tenn.
THE MOBILITY OF "HOT" ELECTRONS AND THEIR INFLUENCE ON THE RISE TIME OF THE PULSES OF SEMICONDUCTOR COUNTERS FROM n-SILICON
O. Meyer and H. J. Langmann [1966] 24 p refs Transl. into ENGLISH from Nucl. Instr. Methods (Netherlands), v. 34, 1965 p 77-87
(ORNL-TR-1051)

The rise time of the pulses in semiconductor counters excited by alpha particles is calculated and compared with measurements on counters fabricated of high resistance n-silicon. The calculation is effected including the strong dependence of the mobility of charge carriers on the high electric field in a semiconductor counter. The case of overvoltage on a fully depleted counter was taken into account, too. Calculated and measured rise times agreed reasonably well, using a fixed set of constants for all counters. For low electric field strengths of the order of 1000 v/cm the governing time constant is the plasma time. Its value for alpha particles was empirically determined to be 1.9×10^{-2}sec . v^2/cm^2. For an average field strength the rise time is strongly influenced by integration of the pulses by the resistance of the counter base together with the input capacitance of the measuring equipment, provided the depletion layer is not extended up to the back contact. Only in a fully depleted counter the rise time is proportional to the transient time of the charge carriers. This transient time even in a not fully depleted counter will depend on the electric field strength in as much as the mobility itself is field dependent. For field strengths of about 30,000 v/cm the transient time and thus the drift velocity are constant, the mobility therefore is inversely proportional to the field strength. The value determined for this maximum drift velocity v_∞ for conduction electrons amounts to 7.4×10^6cm/sec, and for defect electrons to 4.8×10^6cm/sec. Author (NSA)

N66-36997# Oakridge National Lab., Tenn.
A STUDY OF THE LITERATURE OF DIFFUSION BONDING
Paulette Bonnin May 1965 24 p refs Transl. into ENGLISH of Comm. de l'Energie Atomique Rept. No. CEA-BIB-44
(ORNL-TR-851)

The formation of junctions by diffusion in the solid state was studied in the case of materials which are difficult to weld by conventional methods: soldering, brazing, in particular of reactive metals and refractory metals. This literature survey considers the conditions under which junction diffusion may be effected as well as the results obtained and published by various organizations since 1959. Author (NSA)

N66-37118*# Massachusetts Inst. of Tech., Cambridge. Electronic Systems Lab.
ELECTRICAL CONDUCTION PROCESSES IN THIN FILMS OF CADMIUM SULFIDE
James G. Gottling and W. Stewart Nicol Jun. 1966 99 p refs
(Grant Ns6-496; MIT Proj. DSR 6152)
(NASA-CR-78019; ESL-R-272) CFSTI: HC $3.00/MF $0.75
CSCL 20L

Thermally stimulated emission current measurements indicate that the films have two prominent sets of trapping energy levels, one in the range 0.12 eV to 0.17 eV and the other in the range 0.33 eV to 0.37 eV below the conduction band. The effects of post-evaporative treatments of annealing, argon and oxygen ion bombardment, and diffusion of an evaporated sulfur layer, on CdS-metal film barriers are investigated. The voltage de-excitation of optically modulated conductivity depends on pulse duration and is relatively independent of the pulse amplitude. Current-controlled negative resistance is observed both in the steady-state and at low frequencies for CdS-Au and CdS-Ag diodes. P-type CdS films are formed by controlled amounts of Cu doping and P-N CdS diodes fabricated. Author

N66-37172# Soreq Research Establishment, Israel Atomic Energy Commission, Yavneh.
SUPERLINEAR EXCITATION OF THERMOLUMINESCENCE IN DIAMOND Scientific Report No. 7
R. Chen and A. Halperin (Hebrew Univ.) Apr. 1966 11 p refs Presented at the Intern. Conf. on Luminescence, Budapest, Aug. 1966
(Contract AF 61(052)-759)
(AFCRL-66-495; AD-635868) CFSTI: HC $1.00/MF $0.50

The thermoluminescence (TL) of semiconducting diamonds and its dependence on the wavelength of the exciting light and on the dose of excitation was investigated. The strongest glow peak appearing at about 250°K, was found to rise linearly with the dose on excitation at the absorption edge (225 millimicrons), but showed a strong superlinear effect on irradiation with longer wavelengths (280-400 millimicrons). With light near 360 millimicrons this peak was found to rise with the third power of the dose. Illumination with longer wavelengths (500-1000 millimicrons) followed by uv (280-400 millimicrons) resulted in an enhancement of the TL intensity and a reduction in the power factor of the dependence on the dose, compared to those obtained on illumination with the uv light only. Multistage excitation is proposed to account for the observed superlinearity. The illumination with long wavelengths prior to the uv excitation is assumed to excite electrons to one of the intermediate stages. Author (TAB)

N66-37192# Army Missile Command, Huntsville, Ala. Solid State Physics Branch.
THE MOSSBAUER EFFECT
Ambuj Mukerji and C. A. Coulter, ed. 24 Mar. 1966 48 p refs
(RR-TR-66-5; AD-636033) CFSTI: HC $2.00/MF $0.50

The theory of the nuclear Mossbauer effect and its optical analogue are presented. Introductory paragraphs deal with the destruction of resonance fluorescence in case of a freely recoiling nucleus. The partial restoration of resonance by Doppler effect and thermal broadening is outlined. The concept of pero-phonon transitions between bound nuclear states of nuclei embedded in a crystalline lattice is introduced in a simple quantum mechanical language. The classical derivation of the Debye-Waller factor based on the frequency modulation concept is followed by a rigorous quantum mechanical calculation of the zero-phonon transition probability and its temperature dependence. Lipkin's sum rule is discussed. Application of the Mossbauer effect to determine lifetimes of excited states, nuclear quadrupole moments, and the isomeric shifts is shown. The optical analogue in defect solids is described. Author (TAB)

N66-37228# Bausch and Lomb, Inc., Rochester, N. Y. Research and Development Div.

INFRARED COATING STUDIES Final Report, 15 Mar.–15 Jun. 1966

[1966] 13 p refs

(Contract DA-44-009-AMC-124(T))

(AD-635629) CFSTI: HC $1.00/MF $0.50

Families of curves were computed for the convenient-determination of the refractive index of non-absorbing quarterwave films on substrates of known index. The refractive indices of films of ZnTe, ZnS and $PbCl_2$ in their non-absorbing infrared regions were determined. Survey reststrahlen measurements were continued to include crystals of $PbMO_4$, $CaWO_4$, topaz, SiC, GaP and GaAs. Calculations of enhanced reflectance MgO reststrahlen films were carried out. With this technique good rectangular shaped reflection band filters for the 14 to 24 micron region are feasible. Calculations of filters embodying MgO reststrahlen films were made. With them it appears feasible to produce good pass band filters for the 30 micron region, as well as low pass transmission filters cutting sharply at this wavelength. Author

N66-37313*# Chicago Univ., Ill. Dept. of Physics.

SPIN WAVES IN FERROMAGNETIC METALS AND THE DYNAMICAL FORM OF THE LANDAU QUASI-PARTICLE THEORY

Morrel H. Cohen and David R. Penn (Argonne Natl. Lab.) [1966] 24 p refs Prepared in cooperation with Argonne Natl. Lab.

(Grant NsG-352)

(NASA-CR-78249) CFSTI: HC $1.00/MF $0.50 CSCL 20L

The measured change with temperature of spin-wave frequencies in metallic ferromagnets is proportional to $T^{5/2}$. The usual Landau quasi-particle theory would yield an incorrect $T^{3/2}$ term. Successful theories of the $T^{5/2}$ dependence have started out from hamiltonians which may be interpreted as containing dynamical quasi-particle interactions. In the present paper we supply the needed derivation of the dynamical form of the Landau quasi-particle theory for uniform systems and comment on its relation to the previous version of the theory. We show, in effect, that the derivations of the $T^{5/2}$ dependence by Izuyama and by Kawasaki are exact and thus complete the justification of Marshall's original explanations. The connection between the present form of the theory and the original Landau form and its generalizations is briefly indicated. Author

N66-37400# Columbia Univ., New York. Dept. of Electrical Engineering.

A MECHANISM FOR ENERGY TRANSPORT BY EXCITONS Technical Report No. 93

David Redfield 30 Jun. 1966 15 p refs

(Contract Nonr-4259(16))

(CU-2-66-Nonr-4259(16)-EE; AD-635671) CFSTI: HC $1.00/MF $0.50

Detailed consideration of the effects of charged imperfections in solids shows two influences relevant to the question of energy transport associated with excitons. First, such defects create exciton traps, or at least tend to hinder ordinary exciton diffusion. Second, the defects alter the optical absorption in such a way as to provide a new mechanism for energy transport by the photons associated with excitons. Author (TAB)

N66-37440# Navy Underwater Sound Lab., New London, Conn.

THE EFFECT OF AMBIENT BACKGROUND ON THE PERFORMANCE OF LEAD SULFIDE AND SILICON PHOTODETECTORS Research Report, 1963–1965

Gary N. Motin 19 Jul. 1966 24 p refs

(USL-752; AD-636267) CFSTI: HC $1.00/MF $0.50

This report presents a summary of several years of investigation into characteristics of chemically deposited, lead sulfide, near-infrared photoconductors and broad-area, diffused junction, silicon, near-infrared photodiodes exposed to actual and simulated ambient background conditions. Among the parameters tested were voltage-current characteristics, signal and noise characteristics, and frequency response. The silicon operational techniques tested were voltage amplification, current amplification, reverse biasing, transformer coupling, and inductance coupling. It was found that (1) the lead sulfide photoconductive cell still retains its position as an important photodetector for use in low frequency, near-infrared applications, and (2) maximum performance from the diffused junction silicon photodiode is realized when the detector is operated under dc short-circuit conditions. A theoretical discussion of the operation of the two detectors is also presented. Author (TAB)

N66-37444# Soreq Research Establishment, Israel Atomic Energy Commission, Yavneh.

ELECTROLUMINESCENCE IN SEMICONDUCTING DIAMOND AND ITS STIMULATION BY INFRARED Scientific Report No. 6

V. Bar, A. Halperin (Hebrew Univ.), and J. Levinson Apr. 1966 12 p refs Presented at Intern. Conf. of Luminescence, Budapest, Aug. 1966

(Contract AF 61(052)-759)

(AFCRL-66-494; AD-635867) CFSTI: HC $1.00/MF $0.50

The blue electroluminescence (EL) of semiconducting diamonds was measured at 80°K. It was found to be stimulated by irradiation of the crystal with infrared or visible light. The light-stimulated EL depended linearly on both the light intensity and the current, and its excitation spectra was found to follow that of the photo current. Application of an electric field across the crystal at 80°K excited thermoluminescence TL, with the main glow peak at about 270°K. Although infrared for itself did not excite TL at all, its application prior or simultaneously with the electric field was found to stimulate the TL. It is suggested that the infrared light raises valence band electrons to an intermediate energy level in the forbidden gap from which they are excited up to the luminescence centers by the electric field. Author (TAB)

N66-37456# Carnegie Inst. of Tech., Pittsburgh, Pa. Dept. of Mechanical Engineering.

UNCONVENTIONAL METHODS FOR INFLUENCING FLUID FLOW. PART VI: THE EFFECT OF A TRANSVERSE MAGNETIC FIELD ON THE THERMOELECTRIC PROPERTIES OF POLYCRYSTALLINE BISMUTH-ANTIMONY ALLOYS Final Report, Jun. 1963–Apr. 1966

Henry N. Chuang Wright-Patterson AFB, Ohio, AF Aero Propulsion Lab., May 1966 171 p refs

(Contract AF 33(657)-9914)

(AFAPL-TR-64-133, Pt. VI; AD-636257) CFSTI: HC $5.00/MF $1.00

The effect of a transverse magnetic field on the thermoelectric properties (Seebeck coefficient, thermal conductivity, electrical resistivity and figure of merit) of n-type polycrystals of bismuth-antimony alloys containing 0, 5, 12 and 19 atomic per cent antimony in bismuth have been investigated at 90°K and 310°K. Pure bismuth has the largest zero field Seebeck coefficient as well as figure of merit of all the samples tested at both 90°K (−57 microvolts/°K and 0.00043°K) and 310°K (−66 microvolts/°K and 0.00034/°K. The magnetoresistivity of the pure bismuth sample at 90°K is extremely large, (7.5 times its zero field value at 4.1 kilogauss); it is believed due mainly to its special band structure (overlapped energy bands) which is one of the characteristics of semimetals. As a result of its extremely large magnetoresistivity, the figure of merit decreases with field at fields larger than a few hundred gauss. The zero field figure of merit of $Bi_{95}Sb_5$ at 310°K is just slightly smaller than pure bismuth's (0.3×10^{-3}/°K vs 0.34×10^{-3}/°K) but its relative change is much larger so that its figure of merit overtakes pure bismuth's at a field of 4 kilogauss. The figure of merit of $Bi_{88}Sb_{12}$ under the presence of a magnetic field is very promising. It reached a value of about 0.4×10^{-3}/°K at 4.1 kilogauss. The performance of $Bi_{81}Sb_{19}$ both at 310°K and 90°K, with and without a magnetic field, was very disappointing.

Author (TAB)

N66-37580*# Rensselaer Polytechnic Inst., Troy, N. Y.
PHOTOCONDUCTIVITY AND PHOTOTROPY IN NON-CRYSTALLINE SOLIDS
J. D. Mackenzie [1966] 47 p refs Presented at the Intern. Conf. on Radiation Effects on Solids, Cairo, Sep. 1966
(Grant NsG-100-60)
(NASA-CR-78310) CFSTI: HC $2.00/MF $0.50 CSCL 20L

The reversible phenomena of photoconductivity and phototropy are examined in noncrystalline solids and an attempt is made to correlate these phenomena with the structures of the solids. The discussion covers electronic conduction in semiconducting noncrystalline glasses, photoconductivity and structure of noncrystalline selenium, photoconductivity of chalcogenide glasses, phototropic glasses containing silver halides, and phototropic glasses prepared under highly reducing conditions. R.N.A.

27 PROPELLANTS

Includes fuels; igniters; and oxidizers. For basic research see: 06 Chemistry; and 33 Thermodynamics and Combustion. For related information see also: 28 Propulsion Systems.

N66-36548# Florida Univ., Gainesville.
A MATHEMATICAL MODEL FOR DEFINING EXPLOSIVE YIELD AND MIXING PROBABILITIES OF LIQUID PROPELLANTS
E. A. Farber *In* Canaveral Council of Tech. Soc. 3d Space Congr. 1966 p 510–519 refs (See N66-36506 22-30)
(Contract NAS10-1255)

This paper describes how a mathematical model can be constructed to fit theoretical or experimental data on yield and spill of liquid propellants. It shows how these primary quantities can be separated, how probability distributions can be found for each, and how probability confidence regions and confidence limits can be established. The fundamental function of this very general mathematical model, based upon four independent parameters, and the characteristics of the resulting probability surface are discussed in detail. The mathematical model, programmed for an IBM 709 computer, is applied to some spill test data of liquid propellants for which the necessary information is available and then with a minimum number of assumptions to missile failure yield estimates. Author

N66-36549# National Aeronautics and Space Administration. John F. Kennedy Space Center, Cocoa Beach, Fla.
A SYSTEMATIC APPROACH FOR THE ANALYTICAL ANALYSIS AND PREDICTION OF THE YIELD FROM LIQUID PROPELLANT EXPLOSIONS
E. A. Farber (Florida Univ.) and J. H. Deese *In* Canaveral Council of Tech. Soc. 3d Space Congr. 1966 p 530–532 refs (See N66-36506 22-30)
(Contract NAS10-1255)

This paper presents a systematic approach by which the expected yield from liquid propellants can be predicted and furthermore gives an insight into the physical phenomena involved. The yield potential and the mixing function can be determined allowing for the type of propellants, their relative proportions, the reaction rates between the components depending upon mixture composition, the heat transfer rates between the components and the propellants and the surroundings, the mode of failure and the resulting mixing characteristics, and the ignition and reaction delay times. Combining the above information into seven charts as presented leads to a systematic analytical determination of the expected yield. Author

N66-37020# Los Alamos Scientific Lab., N. Mex.
PROJECT ROVER LIQUID HYDROGEN SAFETY: A FIVE YEAR LOOK
T. E. Ehrenkranz [1965] 15 p refs Presented at the Cryogenic Eng. Conf., Boulder, Colo.
(Contract W-7405-ENG-36)
(LA-DC-7689; CONF-660605-2) CFSTI: HC $1.00/MF $0.50

Large scale use of liquid hydrogen has been associated with Project Rover at Jackass Flats, Nevada, since 1959. There were misadventures; these, together with the advice of specialists led to continuing improvements in procedures and equipment. Main components of the liquid hydrogen system are described; incidents and the lessons learned are related and the gradual refinement of safety devices and procedures are traced. It is felt today that standing operating procedures, control over incompatible operations, room inerting, remote control of high hydrogen flow rates and proven equipment reliability make the main contributions to carrying out large scale liquid hydrogen operations with confidence. Author (NSA)

N66-37139*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
COMPARISON OF PROPELLANT SLOSHING PARAMETERS OBTAINED FROM MODEL AND FULL-SIZE CENTAUR LIQUID–OXYGEN TANKS
Andrew J. Stofan Washington, NASA, Sep. 1966 14 p refs (NASA-TM-X-1286) CFSTI: HC $1.00/MF $0.50 CSCL 21I

Propellant sloshing and pendulum analogy parameters are compared for a scale-model and a full-scale Centaur liquid–oxygen tank. Experimental data were obtained in a 1/3.75 scale-model tank and a full-size tank in both an unbaffled and a baffled configuration with water as the contained liquid. The full-size baffled tank configuration was also tested with liquid oxygen as the contained liquid. The fundamental-frequency and damping-ratio parameters show good agreement between the scale-model and full-size tanks for both the unbaffled and baffled tank configurations. The fundamental-frequency and damping-ratio parameters for the baffled tank configuration show no apparent difference between liquid oxygen and water. The pendulum analogy parameters, obtained for the unbaffled tank configuration only, also show good agreement between the model and full-size tanks. Author

N66-37162# United Technology Center, Sunnyvale, Calif. Research and Advanced Technology Dept.
COMPOSITE SOLID PROPELLANT IGNITION MECHANISMS Annual Scientific Report, 1 Apr. 1965–31 Mar. 1966

Larry J. Shannon May 1966 59 p refs
(Contract AF 49(638)-1557)
(UTC-2138-ASRI; AFOSR-66-0935; AD-484048)

Investigation of composite propellant ignition in a shock tube by conductive heating from a doubly compressed stagnant gas has shown that formulation variables exhibit little influence on ignition times in the presence of oxygen. Surface roughness was shown to have a strong influence on ignition times. Ignition time was found to be independent of the manner in which oxygen concentration was changed, i.e., by variation of mole fraction or total pressure. Extension of the hypergolic ignition theory to include adsorption and desorption processes provided a foundation for qualitative and quantitative analysis of the oxygen data. High-speed photographic investigation of composite propellant ignition in an arc-image furnace produced interesting qualitative information. Gasification of what appears to be the binder was observed throughout a major portion of the heating cycle and a molten surface was noted in some formulations prior to ignition. Ammonium perchlorate (AP) decomposition was studied in a high-pressure differential thermal analysis (DTA) apparatus and significant pressure effect on the decomposition rate was observed in the pressure range 15 to 215 psia. TAB

N66-37240# IIT Research Inst., Chicago, Ill. Technology Center.
DETECTION OF WATER IN JET FUEL. ITEM 1: BREADBOARD INSTRUMENT First Bimonthly Progress Report, 21 Apr.–21 Jun. 1966
Martin Salkowski 14 Jul. 1966 20 p
(Contract NObs-94353)
(IITRI-C6091-1-1; AD-635631) CFSTI: HC $1.00/MF $0.50

The objective of the program is to develop two instruments: one for detecting water in jet fuel and the other for detecting water in residual fuel. The basic technique being considered is infrared absorption at the 2.8-μ wavelength. At this point in the infrared spectrum, the extinction coefficient for the HOH structure is large. By utilizing the long wavelengths of light, the extinction coefficient for secondary contamination is small. This specificity will make the instrumentation accurate and reliable. Also, the measurements will be noncumulative, as compared with techniques that the Navy utilizes today. Author (TAB)

N66-37598# France. Office National d'Etudes et de Recherches Aerospatiales, Chatillon-Sous-Bagneux.
PROGRAMED METHOD FOR THE DETERMINATION OF PROPELLANT CHARACTERISTICS (MIXED EXPANSION) [METHODE PROGRAMMEE DE CALCUL DES PERFORMANCES DE PROPERGOLS (DETENTE MIXTE)]
Bernard Crampel, Simone Barrère, and Marie-Paule Lemaitre [1965] 241 p refs In FRENCH; ENGLISH summary
(ONERA-TN-92) CFSTI: HC $6.00/MF $1.50

The programmed method used to determine the characteristics of propellants assuming a mixed expansion is defined. This assumption corresponds to the possibility of fixing the composition of the products from the reaction and from a temperature T_F so that the throat is always in the part in equilibrium. Therefore the choice of this temperature permits an expansion in partial or total equilibrium to be obtained. The program 315-302 concerning the mixed expansion is linked to the computing program of the equilibrium composition whose extension has permitted the computation of the derivatives D_p, D_T of the coefficient γ, and of the velocity of sound. Therefore it concerns one, some or all of the 19 following elements: F, Cl, O, N, H, Li, Be, B, C, Na, Mg, Al, Si, Ti, Zr, Tu, S, P as well as a neutral element (He or A). The method, the programming, and its utilization are described. Some examples permit a familiarization with the different processes and indicate the data necessary for their utilization. The detailed working conditions of the program are described. The possibilities and the general organization of the program are given as well as its fractioning and the various precautions which have to be taken before computation. The fractioning into sub-programs, the Fortran vocabulary, and the symbolic program are given. Author

28 PROPULSION SYSTEMS

Includes air breathing, electric, liquid, solid, and magnetohydrodynamic propulsion. For nuclear propulsion see: 22 Nuclear Engineering. For basic research see: 23 Physics, General; and 33 Thermodynamics and Combustion. For applications see: 31 Space Vehicles. For related information see also: 27 Propellants.

N66-36521# Electro-Optical Systems, Inc., Pasadena, Calif.
ADVANCED POWER CONDITIONING FOR AN ION PROPULSION SYSTEM
John J. Davis *In* Canaveral Council of Tech. Soc. 3d Space Congr. 1966 p 206–228 (See N66-36506 22-30)

The operation of the ion engine, the power conditioning system, and the system testing are described. The engine is a cesium contact 10 mlb high performance ion engine operated at a power/thrust ratio of 175 kW/lb and a specific impulse of 5500 seconds. The 2000 watt power conditioning system, with a projected weight/power ratio of 15 lb/kW, is discussed with respect to the electrical power which translates directly into power in the beam, and the power necessary for engine operation but which has no relation to thrust. Details on the high voltage inverter and its circuitry are given. The testing phase of the complete power conditioning system is outlined. It was concluded that the power conditioning system demonstrated that a long lived ion propulsion system is practical. N.E.N.

N66-36786*# Colorado State Univ., Fort Collins. Coll. of Engineering.
TRANSIENT AND STEADY PERFORMANCE OF AN ION ROCKET THRUST AUGMENTOR Final Report
Jan. 1966 130 p refs
(Grant NsG-570)
(NASA-CR-77855; CER66-67VAS3) CFSTI: HC $4.00/MF $1.00 CSCL 21C

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5. SECONDARY ELECTRON EMISSION R. Bunney 17 p (See N66-36789 22-25)

6. HEAT TRANSFER FROM LARGE DIAMETER PIRANI GAUGES OPERATING DOWN TO A MICROTORR J. E. Braly 47 p refs (See N66-36790 22-33)

N66-36787*# Colorado State Univ., Fort Collins.
OPERATION OF ONE-HALF INCH DIAMETER ION THRUSTOR WITH A COUNTERCURRENT ELECTRON ACCELERATOR
V. A. Sandborn, J. E. Braly, and R. L. Atchley *In its* Transient and Steady Performance of an Ion Rocket Thrust Augmentor Jan. 1966 18 p refs (See N66-36786 22-28) CFSTI: HC $4.00/MF $1.00

An electro optical systems, one-half inch diameter, porous tungsten surface ionization thrustor was operated with a countercurrent electron accelerator system. Increases over space charge limited ion beam currents up to a factor of 7 were obtained with the present geometry. The increase in ion current was proportional to the electron emission. The operation of the electron emitter was limited by electrical breakdown between the ionizer

and the emitter. Evidence is also found to indicate that the electron emitter tends to over focus the beam. The over focus leads to excessive impingment on the negative accelerator for the present accelerator geometry. Author

N66-36794*# Colorado State Univ., Fort Collins. Coll. of Engineering.
ADVANCED ELECTRIC PROPULSION RESEARCH First Semiannual Report
William K. Mickelsen 30 Jun. 1966 221 p refs
(Grant NGR-06-002-032)
(NASA-CR-77939; MER66-67WRM-1) CFSTI: HC $6.00/MF $1.25 CSCL 21C

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2. FUTURE TRENDS IN ELECTRIC PROPULSION W. R. Mickelsen 45 p refs (See N66-36796 22-28)
3. RADIOISOTOPE HEATING OF CONTACT IONIZERS W. R. Mickelsen 18 p refs (See N66-36797 22-28)
4. THE EFFICIENCY OF ELECTRICAL DISCHARGES FOR ELECTRIC PROPULSION K. W. Arnold 37 p refs (See N66-36798 22-28)
5. LUNAR-SUPPLY MISSION STUDY T. D. Fehr and W. R. Mickelsen 18 p refs (See N66-36799 22-28)
6. PROPELLANT FROM SPENT TANKAGE W. R. Mickelsen 7 p refs (See N66-36800 22-28)
7. COLLOIDS FROM CHEMICAL REACTIONS G. W. tompkin, Jr. 46 p refs (See N66-36801 22-06)

N66-36795*# Colorado State Univ., Fort Collins.
COLLOID-PARTICLE ELECTROSTATIC THRUSTORS
William R. Mickelsen *In its* Advanced Elec. Propulsion Res. 30 Jun. 1966 24 p refs Presented at the DGRR Sonnenberg Symp. on Elec. Propulsion, Braunschweig, W. Germany, 24 Feb. 1966 (See N66-36794 22-28) CFSTI: HC $6.00/MF $1.25

Electric rocket lunar ferries will require specific impulses in the range of 1000 to 3000 seconds. Existing electric thrustors have poor efficiency in this range of specific impulse, but colloid-particle thrustors have promise of high efficiency throughout the range of interest. Additional features of colloid-particle thrustors include the promises of high exhaust-jet power density, and adequate durability. Three colloid-particle thrustor concepts have received the most attention: liquid sprays, condensation from vapor, and pre-formed particles. Of these three, the liquid-spray type has the most developed status. Liquid-spray thrustors have been operated at a specific impulse of 450 seconds with an efficiency of 75% and an exhaust power density of 1 kw/m^2. An approximate analysis made herein indicates that durability may be a severe problem. A recent theoretical analysis has shown that the maximum particle formation efficiency that can be expected from condensation-colloid thrustors is less than 50%. Experiments done so far with pre-formed particles indicate that particle agglomeration is a serious problem. Author

N66-36796*# Colorado State Univ., Fort Collins.
FUTURE TRENDS IN ELECTRIC PROPULSION
William R. Michelsen *In its* Advanced Elec. Propulsion Res. 30 Jun. 1966 45 p refs Presented at AIAA 2d Joint Specialists Meeting, Colorado Springs, 13–17 Jun. 1966 (See N66-36794 22-28) CFSTI: HC $6.00/MF $1.25
(AIAA Paper-66-595)

Comparisons are made between chemical, nuclear, and electric propulsion systems for spacecraft, with indications given for future trends in electric methods. Discussions are given for solar-electric propulsion, electric propulsion for satellites, electric rockets for primary propulsion, and advanced concepts in electric propulsion. Predictions are that solar-electric propulsion with a Kaufman type of cesium or mercury ion thrustors can provide substantial payload increases for unmanned vehicles. The choice of electric thrustor systems for attitude and position control of satellites depends on factors such as the thrust level, duty cycle, impulse bit precision, and thrust vector alignment requirements. Existing electric thrustors could be used for planetary orbiter and lander missions in the future, but considerable payload loss would result because of non-ideal thrustor performance. Future developements in electric thrustor types will provide reasonably good performance for planetary orbiter and lander missions. C.T.C.

N66-36797*# Colorado State Univ., Fort Collins.
RADIOISOTOPE HEATING OF CONTACT IONIZERS
William R. Michelsen *In its* Advanced Elec. Propulsion Res. 30 Jun. 1966 18 p refs (See N66-36794 22-28) CFSTI: HC $6.00/MF $1.25

A technical discussion is given of the use of radioisotopes for heating ionizers in contact-ionization thrustors. Various comparisons are made of this method and various other propulsion systems, and the feasibility and possible gains in performance are assessed. On the basis of these comparisons, the cesium-contact thrustor with a Pu-238 ionizer heater appears to offer performance gains over existing thrustors. The disquieting feature of the radioisotope heated contact thrustor is the limitation of operating range due to radioisotope availability. If boosters smaller than the Saturn-V class could be used for electric spacecraft missions, these limitations would be eased somewhat. These applications would be short range, and the question of whether the costs of development of a radioisotope heated contact thrustor system would be worthwhile is cogent to the future of the overall electric propulsion program. It is shown that the application of radioisotope heaters to contact-ionization thrustors for satellite attitude and position control is feasible with regard to radioisotope availability. C.T.C.

N66-36798*# Colorado State Univ., Fort Collins.
THE EFFICIENCY OF ELECTRICAL DISCHARGES FOR ELECTRIC PROPULSION
K. W. Arnold *In its* Advanced Elec. Propulsion Res. 30 Jun. 1966 37 p refs (See N66-36794 22-28) CFSTI: HC $6.00/MF $1.25

Consideration is given to the fundamental processes of gaseous electronics and to their efficiency in a review of electrical discharges for electric propulsion. The important mechanisms are established for each electric propulsion concept, and the concepts are evaluated in such a way that quick comparisons may be made between each of them. The physical mechanisms and magnitudes of the effects are discussed in such areas as ionization by electron impact, ionization by positive ions and atoms, photoionization, thermal ionization, shock waves, thermionic and field emission of positive ions, secondary emission of positive ions, ion products by charge transfer, the formation of negative ions, problems of macromolecules, and discharge mechanisms. C.T.C.

N66-36799*# Colorado State Univ., Fort Collins.
LUNAR-SUPPLY MISSION STUDY
T. D. Fehr and William R. Mickelsen *In its* Advanced Elec. Propulsion Res. 30 Jun. 1966 18 p refs (See N66-36794 22-28) CFSTI: HC $6.00/MF $1.25

An investigation was made of unique mission profiles for lunar-supply missions which involve electric propulsion. The general profiles are (1) various increments of chemical boost in the near earth phase, then electric propulsion to a lunar satellite orbit, followed by chemical deorbit and soft landing, (2) various increments of chemical boost in the near earth phase, then electric propulsion for approach to the moon, followed by chemical propulsion from approach to perilune and then to soft landing, (3) various increments of chemical boost in the near earth phase, then electric propulsion to sub-satellite velocity above the moon, followed by chemical soft land, (4) various increments of chemical boost in

the near earth phase, then electric propulsion to lunar fly-by, followed by chemical propulsion for retro to perilune and to soft landing, (5) round trips composed of combinations of the profiles listed above, and (6) round trips in five using an atmospheric braking upon return to earth. Determinations are included of the optimum profiles, the potential payload capability, and the requirements that relate to the electric propulsion systems. C.T.C.

N66-36800*# Colorado State Univ., Fort Collins.
PROPELLANT FROM SPENT TANKAGE
William R. Mickelsen *In its* Advanced Elec. Propulsion Res. 30 Jun. 1966 7 p refs (See N66-36794 22-28) CFSTI: HC $6.00/MF $1.25

An investigation is presented of the feasibility of using spent tankage as a possible source of propellant for electric spacecraft. Chemical rocket propellant tanks are expected to be made of aluminum because of its superior fracture resistance at cryogenic temperatures. It melts at a reasonably moderate temperature (932°K) for conversion to the vapor state, and could then be fed into electric thrustors as propellant. A precise evaluation of performance gains is made in a simple, closed-formed analysis, and shows that the greatest gains are obtained for the more difficult missions. C.T.C.

N66-36857*# General Electric Co., Cincinnati, Ohio. Flight Propulsion Div.
ANALYSIS OF OVERALL AND INTERNAL PERFORMANCE OF VARIABLE-GEOMETRY ONE- AND TWO-STAGE AXIAL-FLOW TURBINES
E. E. Flagg 30 Apr. 1966 153 p ref
(Contract NAS3-7262)
(NASA-CR-54449; GE-R66FPD259) CFSTI: HC $3.25/MF $1.00 CSCL 21A

Performance variations are analyzed for variable geometry single state and two-stage axial flow turbines, and performance maps are presented in the form of equivalent work versus equivalent weight-flow-speed parameter with contours of total pressure ratio. Mean section incidence angle, rotor-hub Mach number, and rotor-hub reaction versus equivalent work are also given. Peak efficiency for the single stage turbine was .901, .866, and .910, respectively, for three performance maps with stators at design point, open, and closed positions. For the two-stage turbine, nine performance maps were computed with the first and second stage stators at the three positions. Pitchline effective areas associated with the stator positions were 130% open and 70% closed on both stators for a net area change of 186% over minimum. Representative points are evaluated in detail, and numerous graphs illustrate the results. M.W.R.

N66-37046*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
PROGRESS IN AIRCRAFT GAS TURBINE ENGINE DEVELOPMENT
Abe Silverstein Washington, NASA, 1966 30 p refs Presented at Intern. Council of the Aeron. Sci. 5th Congr., London, 12–16 Sep. 1966
(NASA-TM-X-52240) CFSTI: HC $2.00/MF $0.50 CSCL 21E

Proposals on gas turbine engines now in design and development show turbine-inlet temperatures much higher than those now used in airline operations. The status of some research and development efforts on materials and cooling and a summary of supersonic inlet-engine matching problems is given to provide a basis for discussing the selection of realistic "design" values of turbine-inlet temperature for use in the engines of advanced aircraft. Interesting recent studies on the use of liquid methane as an aircraft fuel, and researches on noise attenuation of the turbofan engines are also briefly outlined. Author

N66-37126*# Israel Program for Scientific Translations, Ltd., Jerusalem.
SOVIET ROCKETRY—SOME CONTRIBUTIONS TO ITS HISTORY
A. A. Blagonravov et al ed. 1966 224 p refs Transl. into ENGLISH of the book "Iz Istorii Raketnoi Tekhniki" Moscow, Izd. Nauka, 1964 Published for NASA and NSF
(NASA-TT-F-343; TT-66-51023; IPST-1525) CFSTI: HC $3.75/MF $1.25 CSCL 21H

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N66-37127*# Israel Program for Scientific Translations, Ltd., Jerusalem.
WORK ON ROCKETRY IN RUSSIA FROM THE SECOND HALF OF THE 19TH CENTURY DOWN TO 1917 (ACCORDING TO THE MATERIALS OF THE AIM ARCHIVE) [RABOTY PO RAKETNOI TEKHNIKE V ROSSII SO VTOROI POLOVINY XIX V. DO 1917g. (PO MATERIALAM ARKHIVA AIM)]
V. A. Tarasova *In its* Soviet Rocketry 1966 p 1–23 refs (See N66-37126 22-28) CFSTI: HC $3.75/MF $1.25

Rocketry achievements connected with the Petersburg Rocket Institute (PRZ) are surveyed briefly beginning with 1839. Historical accounts are reviewed to show that the PRZ worked out and realized solid propellant rocket designs, and established basic production technology by developing a wide range of tools and machines. In the 1860s, scientific experiments with a ballistic pendulum, new design methods, and improved manufacturing technology resulted in the construction of a less dangerous, longer range military rocket, capable of protracted storage and with a wide range of military applications. Several schemes for various types of rockets are discussed, along with proposed solutions to the problems of flight stability range. Details are given on the more extensive research into the planning and manufacture of

solid propellant rockets which began early in the 20th Century. Sketches of experimental rocket designs, various types of stabilizers, and launching stands are included. M.G.J.

N66-37128*# Israel Program for Scientific Translations, Ltd., Jerusalem.

THE WORK OF RUSSIAN SCIENTISTS ON THE FOUNDING OF A THEORY OF INTERPLANETARY FLIGHT [RABOTY OTECHESTVENNYKH UCHENYKH PO SOZDANIYU OSNOV TEORII MEZHPLANETNYKH SOOBSHCHENII]

V. N. Sokol'skii *In its* Soviet Rocketry 1966 p 24–40 refs (See N66-37126 22-28) CFSTI: HC $3.75/MF $1.25

Jet aircraft proposed in Russia during the 19th Century are classified according to lighter-than-air (jet aerostats), heavier-than-air (jet airplanes), and heavier-than-air (rocket aircraft). Theoretical studies on the problems of interplanetary flight are surveyed, along with the approaches taken by 20th Century scientists to the complex problems of designing and constructing interplanetary rockets. It is claimed that during the first third of the 20th Century, Soviet space flight theoreticians proposed the use of liquid propellant rocket engines; metallic propellants of high calorific power; multi-assembly and multistage rockets; such forms of energy as atomic and electrojet engines, and solar pressure; wings for glide landings on the earth and other planets possessing an atmosphere; and the creation of intermediate interplanetary bases in the form of artificial satellites of the earth and other celestial bodies. The use of the structural material of the rocket itself as supplementary fuel was also proposed. M.G.J.

N66-37129*# Israel Program for Scientific Translations, Ltd., Jerusalem.

A CONTRIBUTION TO THE HISTORY OF THE DEVELOPMENT OF SOVIET JET ENGINEERING DURING THE 1930's [IZ ISTORII RAZVITIYA REAKTIVNOI TEKHNIKI V SSSR V TRIDTSATYE GODY XX VEKA]

I. A. Merkulov *In its* Soviet Rocketry 1966 p 41–67 refs (See N66-37126 22-28) CFSTI: HC $3.75/MF $1.25

Technical details on Soviet rockets and rocket engines developed during the 1930s are summarized, and experimental research on rocket aircraft is discussed. It is stated that between 1932 and 1941 more than 100 rocket engines of various types were designed, and that many aerial rocket launches proved successful. The theoretical foundations of rocketry are reviewed, with emphasis placed on the work of Soviet scientists in rocket power engineering, rocket dynamics, and gas dynamics. M.G.J.

N66-37131*# Israel Program for Scientific Translations, Ltd., Jerusalem.

K. E. TSIOLKOVSKII—FOUNDER OF THE THEORY OF MULTISTAGE ROCKETS [K. E. TSIOLKOVSKII—OSNOVOPOLOZHNIK TEORII MNOGOSTUPENCHATYKH RAKET]

V. F. Kotov *In its* Soviet Rocketry 1966 p 85–126 refs (See N66-37126 22-28) CFSTI: HC $3.75/MF $1.25

A historical-critical survey is presented on the theories of staged rockets developed through the work of Soviet scientists in the 1930s. The role and significance of Tsiolkovskii's fundamental ideas and proposals in the development of multistage rockets are reviewed and discussed in terms of the methods and suggestions of contemporary rocket dynamics. The fundamental theory of simple rocket motion and its elementary applications are discussed, and the basic theory of generalized Tsiolkovskii (Ts) multistage rockets is developed. The general characteristics of four types of multistage rockets are examined. For comparative analysis, a summary table is presented to permit a dimensionless evaluation of the Ts rockets with several actual or projected contemporary multistage rockets. M.G.J.

N66-37132*# Israel Program for Scientific Translations, Ltd., Jerusalem.

K. E. TSIOLKOVSKII'S CORRESPONDENCE WITH THE JET SCIENTIFIC RESEARCH INSTITUTE (ACCORDING TO THE MATERIALS OF THE ARCHIVE OF THE ACADEMY OF SCIENCES OF THE USSR) [PEREPISKA K. E. TSIOLKOVSKOGO S RNNI (PO MATERIALAM ARKHIVA AN SSSR)]

S. A. Shlykova *In its* Soviet Rocketry 1966 p 127–132 refs (See N66-37126 22-28) CFSTI: HC $3.75/MF $1.25

In the letters presented, mention is made of several articles contributed by Tsiolkovskii to the Jet Scientific Research Institute (RNNI) established in 1934. A brief outline of the RNII work program which he suggested is also included. M.G.J.

N66-37134*# Israel Program for Scientific Translations, Ltd., Jerusalem.

F. A. TSANDER'S ENGINEERING CONTRIBUTIONS TO ROCKETRY [INZHENERNYE RAZRABOTKI F. A. TSANDERA V OBLASTI RAKETNOI TEKHNIKI]

E. K. Moshkin *In its* Soviet Rocketry 1966 p 156–170 refs (See N66-37126 22-28) CFSTI: HC $3.75/MF $1.25

In discussing the features of the engines computed, designed, and built by Tsander, details are given on the ER-1 gasoline jet engine, the liquid oxygen ER-2, the 02 jet engine with antichamber, the liquid propellant GIRD-X, and the M-29 in which cooling by fire-resistant insulation and by a flow system was used. Combustion chamber designs are also considered, including a combination of pump and injector feed, combined fuel and oxidant, increased fuel caloricity by combustion of metal, and increase of the ejected mass through indrawn air. Fuel feed and turbopump feed systems concepts are briefly reviewed. M.G.J.

N66-37135*# Israel Program for Scientific Translations, Ltd., Jerusalem.

Yu. V. KONDRATYUK'S UNPUBLISHED PAPER "TO THEM THAT WILL READ IN ORDER TO BUILD" [O NEOPUBLIKOVANNOI RABOTE Yu. V. KONDRATYUKA "TEM, KTO BUDET CHITAT', CHTOBY STROIT' "]

B. N. Vorob'ev and V. N. Trostnikov *In its* Soviet Rocketry 1966 p 171–192 refs (See N66-37126 22-28) CFSTI: HC $3.75/MF $1.25

A critical review is presented on this 1919 manuscript which is stated to be one of the first Soviet textbooks on rocket theory fundamentals. Basic ideas pertaining to space flight are surveyed, and the theoretical formula for the weight of a rocket fuel is given. Systems other than thermochemical rockets are briefly considered, along with the general shape of projectiles, complications introduced by the atmosphere, mirrors for the collection of solar light, and flight theories. M.G.J.

N66-37591# Institut Franco-Allemand de Recherches, St. Louis (France).

ON THE EFFECT OF SPIKES ATTACHED IN FRONT OF AN ENGINE IN SUBSONIC SPEEDS [UEBER DIE WIRKUNG VON EINEM FLUGKOERPER VORGESCHALTEN SPIESSEN (SPIKES) IM UNTERSCHALL]

R. Ramshorn 16 Jul. 1965 30 p refs In GERMAN (ISL-T-24/65) CFSTI: HC $2.00/MF $0.50

Control effects of spikes, fastened to the noses of stabilized winged bodies, were studied by varying their angles of incidence in relation to the models horizontal axes. An increased angle of incidence together with increased spike thicknesses and lengths resulted in increased displacement of the momentum curve and decreased stability. Axial force curves shifted to higher values with minimal slope derivations. Author

N66-37600# Library of Congress, Washington, D. C. Aerospace Technology Div.
INVESTIGATION OF GAS-TURBINE EXHAUST DUCTS [ISSLEDOVANIYE VYKALOPNYKH PATRUBKOV GAZOVYKH TURBIN]
A. I. Rasputnis and N. N. Bukharin 28 Jul. 1966 20 p refs Transl. into ENGLISH from Izv. Vyssh. Ucheb. Zaved., Energ. (Minsk), no. 9, 1965 p 38–46
(ATD-66-31)

An investigation of gas-turbine exhaust ducts states that the designing of the exhaust duct profile, i.e., the selection of the shape of its meridian- and transfer-cross sections, is done in order to obtain minimal size, weight, hydraulic losses, and minimal nonuniformity in the gas velocity and gas pressure fields with the maximal diffusivity effect. The effect of improving the exhaust duct on the gas turbine's efficiency is shown by examining the gas flow processes in the turbine and exhaust duct simultaneously. The aerodynamic qualities of the exhaust duct were evaluated by blow-through tests using the duct itself or a model of it. The author discusses these tests at some length expressing the results in graph form. The author concludes that the hydraulic losses in the exhaust duct substantially affect the efficiency of a gas turbine; thus, the reduction of the hydraulic drag coefficient of the exhaust duct from 1.83 to 0.90 made it possible to raise the turbine's efficiency 4–5%. The author adds three other conclusions concerning reduction of hydraulic losses in the exhaust duct, the use of toric dividers in the radial-annular deflection region, and the smallest hydraulic drag coefficient obtained with an exhaust duct. Author

29 SPACE RADIATION

Includes cosmic radiation; solar flares; solar radiation; and Van Allen radiation belts. For related information see also: 13 Geophysics; and 24 Physics, Atomic, Molecular, and Nuclear.

N66-36793# Maryland Univ., College Park. Dept. of Physics and Astronomy.
ORIGIN AND LOSS OF INNER ZONE PROTONS
A. M. Lenchek Aug. 1965 24 p refs Presented at the Advanced Study Inst., Bergen
(TR-524; AD-634704) CFSTI: HC $1.00/MF $0.50

The first particles detected in the Van Allen radiation belt were energetic protons near L=1.2. The suggestion made by Singer that the radiation consisted of protons in the 100-MeV range generated by the decay of cosmic ray albedo neutrons seems still to be valid. The theory is able to account for observations to better than an order of magnitude. However, the region of space in which the theory works is very small, less than one percent of the magnetosphere. Scattering by hydromagnetic waves seems to limit stable trapping to this small region above the magnetic equator. Low energy protons of unknown origin are superimposed on the proton belt of cosmic ray albedo origin. Author (TAB)

N66-36807*# Rice Univ., Houston, Tex. Dept. of Space Science.
SUMMARY OF RELEVANT PARTICLE MEASUREMENTS MADE FROM SATELLITES *In its* Satellite Observations of Particle *In its* Satellite Observations of Particle Fluxes and Atmospheric Emissions [1966] 22 p refs (See N66-36806 22-30) CFSTI: HC $2.00/MF $0.50

The relation of satellite measurements, at altitudes between 200 km and 3000 km, to auroras is discussed, and some broader questions on the origins and causes of particle precipitation are summarized. Preliminary studies on satellite observations of particle precipitation are reviewed, and analytical data presented. An aurora, as distinguished from airglow, is here defined as the phenomenon of atmospheric excitation due to direct bombardment of atmospheric constituents by non-thermal (i.e., energetic) charged particles. The literature surveyed indicates that while there are increasingly comprehensive measurements of particle precipitation, the basic dynamical causes are still unknown and it is difficult to formulate a definitive experiment in this regard. It is known, however, that there is always finite precipitation in the auroral zone, so that the unknown source must be continuously active. The latitude and diurnal variations of electron and proton precipitation are discussed in detail. R.Li.

N66-37077# Midwestern Universities Research Association, Stoughton, Wis.
A SEARCH FOR MASSIVE PARTICLES IN COSMIC RAYS
B. Dayton, F. Mills, C. Radmer, L. W. Jones (Mich. Univ.), U. Camerini (Wisconsin Univ.) et al 18 Apr. 1966 28 p refs
(Contracts AT(11-1)-718) Nonr-1224(23))
(MURA-718; AD-635818) CFSTI: HC $1.00/MF $0.50

A search for long-live particles ($>10^{-6}$sec) of mass in the range of about 5–15 BeV was carried out among cosmic rays at the summit of Mt. Evans, Colorado, by measuring time intervals between the arrival of strongly interacting particles of energy $\geq$70 GeV and accompanying air shower particles. From the absence of delayed strongly interacting particles in the range 40—180 ns where particles of nucleonic mass are not allowed, it is concluded that an upper limit of 160 μb/nucleon could be placed on the cross-section for production of particles of mass around 8 BeV at energies not far above threshold in nucleon-nucleon collisions. This limit is subject to certain restrictive assumptions about the behavior of the hypothetical massive particles, which are discussed. Author (TAB)

N66-37209*# State Univ. of Iowa, Iowa City. Dept. of Physics and Astronomy.
MODEL RING CURRENT BELTS
S.-I. Akasofu Jul. 1966 63 p refs *Its* Rept.-66-28
(Grants NsG-233-62; NsG-201-62)
(NASA-CR-78122) CFSTI: HC $3.00/MF $0.75 CSCL 20H

Some numerical results of an extensive calculation of model storm-time radiation belts or the so-called ring current belts are tabulated. The models are constructed by choosing most plausible sets of the six parameters that characterize the belts. R.N.A.

N66-37210*# State Univ. of Iowa, Iowa City. Dept. of Physics and Astronomy.
EXPLORER 12 OBSERVATIONS OF CHARGED PARTICLES IN THE INNER RADIATION ZONE
K. L. Ackerson and L. A. Frank Jun. 1966 46 p refs *Its* Rept.-66-13
(Grant NsG-233-62; Contract Nonr-1509(06))
(NASA-CR-78123) CFSTI: HC $2.00/MF $0.50 CSCL 20H

Measurements of energetic charged particles in the inner radiation zone with two shielded, omnidirectional Geiger-Mueller tubes flown on Explorer 12 have been used to construct B-L contours of the omnidirectional intensities of protons $E_p>21$MeV and $E_p>70$MeV for the period 16 August to 19 September, 1961, prior to the Starfish high-altitude nuclear burst on 9 July 1962. The values of proton ($E_p>21$MeV) omnidirectional intensities are in substantial agreement with the post-Starfish values from Telstar 2 and with other observations. Upper limits for the omnidirectional intensities of electrons $E_e>1.6$MeV at the geomagnetic equator before the Starfish test are also given. Author

N66-37245# California Univ., Berkeley. Space Sciences Lab.
LONGITUDE DISTRIBUTION OF PROTON FLARES AS A FUNCTION OF RECURRENCE PERIOD

John M. Wilcox and Kenneth H. Schatten 6 Jul. 1966 13 p refs *Its* Ser. 7, Issue 25
(Contract Nonr-3656(26))
(AD-635974) CFSTI: HC $1.00/MF $0.50

The longitude distribution of the solar flares that produced high-energy protons detected at the earth during the past 11-year sunspot cycle is examined. The synodic rotation period is not confined to be the Carrington period (27.2753 days), which corresponds to the use of heliographic longitude, but instead a range of rotation periods from 25 to 34 days is examined in increments of 0.01 days. It is concluded that the apparent tendency of these proton flares to cluster within one hemisphere of heliographic longitude is not statistically significant. Author (TAB)

N66-37285*# Consultants and Designers, Inc., Arlington, Va.
ON THE NATURE OF X-RAY EMISSION OF RADIOGALAXIES
I. S. Shklovskiy 5 Aug. 1966 17 p refs Transl. into ENGLISH of the RUSSIAN Manuscript "O Prirode Rentgenovskogo Izlucheniya Radiogalaktik" Submitted for Publication
(Contract NAS5-9299)
(NASA-CR-78203; ST-IGA-10506) CFSTI: HC $1.00/MF $0.50 CSCL 20H

Investigated are the physical conditions in optical condensations of Cygnus A, where the mass of gas present is $\sim(1-3)\cdot10^8 M_\odot$. The thermal (bremmstrahlung) emission in the central part of that source may be the possible cause of X-ray emission of Cygnus A. The extension of this radiation in the optical frequency band is constituted by the continuous spectrum of the central part of Cygnus A. The mass of the hot plasma ($T_e=5\cdot10^7$) must be $>10^{11}M_\odot$. The comparatively dense cold condensations in this plasma are responsible for the optical emission. By their nature these condensations are analogous to the stationary condensations in Cassiopea A. Another possible cause of X-ray emission of Cygnus A may be the continuing activity of its nucleus, of which the dimensions must be quite small. An analogous situation may also arise in the case of the source in Virgo A, though the possibility of X-ray emission of this object being a high-frequency extension of ejection's synchrotron radiation apparently appears to be more probable. If the X-ray sources of radiogalaxies are linked with the continuing activity of their nuclei, the variability of this radiation flux can be expected. Author

N66-37306*# State Univ. of Iowa, Iowa City. Dept. of Physics and Astronomy.
ON THE LOCAL-TIME DEPENDENCE OF OUTER RADIATION ZONE ELECTRON (E > 1.6MeV) INTENSITIES NEAR THE MAGNETIC EQUATOR
L. A. Frank May 1965 34 p refs *Its* Rept.-65-14
(Grant NsG-233; Contract Nonr-1509(06))
(NASA-CR-78233) CFSTI: HC $2.00/MF $0.50 CSCL 04A

A discussion is presented on the local-time dependence of the radial extent of energetic electron (E > 1.6 MeV) intensities in the outer radiation zone near the geomagnetic equator observed with Explorer 14. Observations of magnetospheric phenomena with Explorer 14 included approximately 300 passes with reasonable continuous telemetry coverage through the outer radiation zone. Figures are presented which contain representative sets of contours of the shielded 302 G.M. tube response to penetrating outer zone electrons (E > 1.6 MeV) as a function of geocentric radial distance for selected ranges of magnetic latitude and of local time of satellite apogee position. The diurnal variations of electron (E > 1.6 MeV) intensities observed near the geomagnetic equatorial plane are consistent with the expected distortion of the geomagnetic field in these regions by the solar wind. S.P.

N66-37384*# Consultants and Designers, Inc., Arlington, Va.
STRUCTURE OF THE SOLAR CORPUSCULAR STREAM AND ITS INTERACTION WITH THE EARTH'S MAGNETOSPHERE [STRUKTURA SOLNECHNOGO KORPUSKULYARNOGO POTOKA I VZAIMODEYSTVIYE YEGO S MAGNITOSFEROY ZEMLI]
Yu. D. Kalinin and E. I. Mogilevskiy 27 Oct. 19 refs Transl. into ENGLISH from the book "Issledovanie Kosmicheskii Prostranstva, Trudy Ysesoyuznoy Konferentsii po Fizike Kosmicheskii Prostranstva" Moscow, "Nauka" Publishing House, Sep. 1965 p 368-381
(Contract NAS5-3760)
(NASA-CR-78209; ST-PF-SP-GM-10405) CFSTI: HC $2.00/MF $.50 CSCL 04A

On the basis of various probe and ground observations with particular reference to the results of observations by Mariner-2 IMP-1 and other artificial satellites, the determinant role of corpuscular stream's magnetic field in the transfer of perturbations to Earth's magnetosphere is established. These comparisons suggest the existence of a direct correlation between the D_i-variations of the geomagnetic field and the field variations beyond the limits of the Earth's magnetosphere. It is to be noted that these peculiarities of stream's magnetic field interaction with the Earth's magnetosphere may, at further quantitative development, be explained by the scheme earlier considered, just as would be the case for the part or entire plasma acceleration of the upper magnetosphere attending the geomagnetic variations. At the same time the properties of the strongly magnetized collisionless plasma of the magnetosphere, allowing the penetration and the progress of the solar flux in the form of a magnetic piston, external relative to magnetosphere field, must be taken into account. Author

N66-37470# European Space Research Organization, Paris (France).
ON THE THEORY OF ULTRAVIOLET RADIATION
S. R. Pottasch (Groningen Univ.) May 1966 16 p refs Lecture given at ESRO Summer School, Alpbach, Austria, 20 Jul.-12 Aug. 1965
(ESRO-SM-56) CFSTI: HC $1.00/MF $0.50

Various experimental methods of determining the electron density and temperature of the upper solar atmosphere are reviewed, and data on the structure of the solar chromosphere and corona are tabulated. Observations on the solar eclipse are summarized, and the continuum radiation of the K-corona produced by electron scattering is considered for calculating electron density. Measurements based on the observation of continuum intensity around the Balmer discontinuity at 3650 Å and at 4700 Å are also discussed. The experimental procedure consists of placing the slit of a spectrograph in the eclipse direction so that the moon uncovers different levels of the chromosphere and the corona along the slit direction. For determining electron temperature, measurement techniques as a function of height are assessed for the Ca II lines, the helium lines, and the forbidden lines of highly ionized iron. Results indicate the difficulty of determining the electron temperature at a given height in the solar atmosphere, particularly in the region from 2000 to 50,000 km where the ultraviolet lines are formed. M.G.J.

N66-37471# European Space Research Organization, Paris, (France).
OBSERVATIONS OF SOLAR ULTRAVIOLET RADIATION
H. E. Hinteregger (AFCRL) Mar. 1966 7 p refs Lecture given at ESRO Summer School, Alpbach, Austria, 6 Aug. 1965
(ESRO-SM-57) CFSTI: HC $1.00/MF $0.50

In view of the fact that the subject of his lectures is well covered by a number of recent review articles including one by himself, the author restricts himself to a brief discussion of the main scientific objectives of present-day solar uv observations. The most important instrumental problems are reviewed. The opinion is stated that several comparatively simple satellites seem to be better suited for investigating the solar uv spectrum than a very complex spacecraft carrying many sophisticated experiments. Author (ESRO)

N66-37474# European Space Research Organization, Paris (France)
COSMIC RADIATION
P. Marsden (Leeds Univ.) May 1966 27 p refs Lecture Given at ESRO Summer School, Alpbach, Austria, 20 Jul.–12 Aug. 1965
(ESRO-SM-55) CFSTI: HC $2.00/MF $0.50

The major features of the cosmic radiation are presented essentially from an experimenter's point of view. The first part is devoted to the general characteristics of the cosmic rays: composition, energy spectra, anisotropy. In the second part the motion of a cosmic-ray particle is discussed. Some methods of monitoring cosmic-ray intensity are briefly described: the most useful type of ground-based recorder is the neutron monitor, followed by the μ-meson telescope. Some intensity variations are described (11-year and diurnal variations, Forbush effect, cosmic-ray flares), and the theory of cosmic-ray modulation is discussed invoking Parker's solar wind model. ESRO

N66-37485# European Space Research Organization, Paris (France).
CELESTIAL GAMMA-RAYS: OBSERVATIONAL ASPECTS
G. W. Hutchinson (Southampton Univ.) Apr. 1966 22 p refs
(ESRO-SM-61) CFSTI: HC $1.00/MF $0.50

The most important characteristic parameters of celestial gamma rays, such as spectrum, angular distribution and variations in time are briefly reviewed. The various ways of observations of gamma rays are listed. The experimental results obtained so far are summarized. Author (ESRO)

N66-37487# Royal Inst. of Tech., Stockholm (Sweden). Div. of Plasma Physics.
SOLAR MAGNETIC FIELDS
H. Alfven 26 Mar. 1965 25 p refs Submitted for Publication
(Rept.-65-17) CFSTI: HC $1.00/MF $0.50

Measurements of the longitudinal Zeeman effect in the solar caps with the solar magnetograph developed by Babcock and Babcock revealed irregular fluctuations in the effective magnetic field during short periods of time. Measurements were made near the solar meridian treating both an assumed homogeneous photosphere model and an inhomogeneous solar atmosphere model. The existence of observed microspots may explain the observed variations in the Zeeman effect displacement although they are theoretically arguable because of the existant vertical currents in the solar atmosphere. The pattern of electric currents in the sun is therefore discussed and mapping of the current system gives a new aspect of the electromagnetic phenomena. Finally, the solar activity and its irregularity are looked at. A general conclusion drawn from the measurements by the solar magnetograph in the polar caps is that the Zeeman effect variations are due to the sun's general magnetic field variations but more likely to changes in the photospheric wind, or in the microspot activity, or a combination of these and possibly other factors. ESRO

N66-37490# European Space Research Organization, Paris (France).
THEORETICAL ASPECTS OF SOLAR X-RADIATION
C. de Jager (Sterrewacht Sonnenborgh) Feb. 1966 30 p refs Lecture given at ESRO Summer School, Alpbach, Austria, 11 Aug. 1965
(ESRO-SM-62) CFSTI: HC $2.00/MF $0.50

After a short review of the parameters which are important in the theory of solar X-rays, the production of X-rays by the quiet corona is discussed invoking the theory of radiation emission in an optically-thin plasma. A comparison is made between theoretical predictions and observational data. In the last part, the so-called nonthermal X-rays, and their production in the course of solar outbursts are considered. As an example, one particle flare is discussed quantitatively, also comparing X-ray data with information obtained from radio observations from radio observations. Author (ESRO)

N66-37491# European Space Research Organization, Paris (France).
THEORETICAL ASPECTS OF EXTRATERRESTRIAL X-RAYS OF NON-SOLAR ORIGIN
L. Biermann (Max-Planck-Inst. fuer Physik und Astrophysik) Apr. 1966 20 p refs Lecture given at ESRO Summer School, Alpbach, Austria, 20 Jul.–12 Aug. 1965
(ESRO-SM-58) CFSTI: HC $1.00/MF $0.50

In the first part of this lecture, the author discusses stars as possible sources of X-rays with wavelength between about 10 Å and 100 Å. The crucial question is under what conditions do stars posses a corona which would emit quasi-thermal X-rays in this range, similar to the sun. It is shown that with somewhat improved instruments, we could probably detect X-ray fluxes from a number of bright stars. A list of such stars is included. In the second part, the production of hard X-rays (below 10 Å) by bremsstrahlung and synchrotron radiation in various celestial bodies, as well as by thermal radiation in neutron stars are considered. On the basis of the scarce observational evidence it is difficult to rule out any of the production mechanisms considered. However, some of them appear more likely sources of detectable X-ray sources than others. Author (ESRO)

N66-37507# European Space Research Organization, Paris (France).
EXPERIMENTAL OBSERVATIONS OF PRIMARY COSMIC-RAY ELECTRONS
L. Scarsi (Milan Univ.) Apr. 1966 30 p refs Presented at the ESRO Summer School, Alpbach, 20 Jul. – 30 Aug. 1966
(ESRO-SM-66) CFSTI: HC $2.00/MF $0.50

In the introduction, some of the astrophysical implications of studies on the galactic cosmic ray electrons are mentioned. The various difficulties encountered in the measurement of these electrons are discussed. The experimental results which were obtained so far by balloon-borne and also by satellite-borne instruments are critically reviewed. A summary of the results is presented. Author (ESRO)

N66-37511# Bologna Univ. (Italy). Inst. of Physics.
LOW-ENERGY COSMIC-RAY PHOTONS IN ATMOSPHERE
D. Brini, V. Ciriegi, F. Fuligni and E. Moretti 1965 26 p refs
CFSTI: HC $2.00/MF $0.50

X-ray detectors, with directional properties, have been launched by balloons in order to study the soft photon component of the cosmic radiation in atmosphere. The experimental data can be reasonably justified in a quantitative way by assuming that the electron component generates the greatest part of the X-rays by bremsstrahlung. The high value of the intensity measured is due to the strong effect of scattering and degradation suffered by higher energy photons. A contribution to the X-ray production by slow neutrons, through the $N^{14}(n,\gamma)N^{15}$ interactions, cannot be excluded; an upper limit of such a contribution may be of the order of about 1%. Author (ESRO)

N66-37514# European Space Research Organization, Paris (France).
SOME UNRESOLVED PROBLEMS IN THE CORPUSCULAR COSMIC RADIATION
B. Peters (Copenhagen Univ.) Mar. 1966 24 p refs
(ESRO-SM-64) CFSTI: HC $1.00/MF $0.50

Some of the most important problems in present and future cosmic ray research are considered. In the first part the role played by cosmic rays in the evolution of the solar system is discussed, as well as methods of obtaining information on the history of both galactic and solar cosmic rays. In the second part, it is shown how the production and acceleration of galactic cosmic rays as well as fragmentation in interstellar space may be investigated by carrying out specific measurements. A list of such experiments is given and the technical difficulties involved are discussed. The last part deals with the measurement of solar neutrons and its implications for the study of solar transient phenomena. Author (ESRO)

N66-37517*# State Univ. of Iowa, Iowa City. Dept. of Physics and Astronomy.
THE ADIABATIC MOTION OF OUTER ZONE PARTICLES IN A MODEL OF THE GEOELECTRIC AND GEOMAGNETIC FIELDS
Harold E. Taylor Jun. 1966 52 p refs *Its* Rept.-66-24
(Grant NsG-233-62)
(NASA-CR-78394) CFSTI: HC $3.00/MF $0.50 CSCL 04A

Calculations of charged particle motions are carried out in a model of the earth's magnetosphere which includes both a magnetic field and an electric field. The magnetic field is an analytical approximation of the real field, based on extensive satellite measurements, while the electric field is deduced in the ionosphere from ionospheric current system and mapped throughout the magnetosphere by assuming that the magnetic field lines are equipotentials. Using this model the motions of charged particles are calculated by assuming that the first two adiabatic invariants, μ and J, and the total energy K are all conserved. Particle fluxes are then calculated by invoking Liouville's theorem. The computations are done numerically on the IBM 7044 computer, and the results obtained for outer zone electrons are in agreement with experimental measurements of the Injun 3 satellite. Author

30 SPACE SCIENCES

Includes astronomy and astrophysics; cosmology; lunar and planetary flight and exploration; and theoretical analysis of orbit and trajectory. For related information see also: 11 Facilities, Research and Support; and 31 Space Vehicles.

N66-36463# Grumman Aircraft Engineering Corp., Bethpage, N. Y.
COMPARISON OF SEVERAL RANGE OPTIMAL ALTITUDE CONSTRAINED STEEP ORBITAL REENTRY TRAJECTORIES
J. W. Voss Dec. 1965 20 p refs
(LRC-66-336)

An application of the gradient method optimization technique to lifting reentry vehicles is described. Two-dimensional maximum range trajectories are found, which include a 10 G pull-out load factor limit and a prescribed limitation on maximum skip-up altitude. The use of weighting functions to speed convergence of the iterative method is discussed. It is shown that the present IBM 7094 computer program achieves satisfactory results, but automatic convergence computer logic should be incorporated to obviate manual intervention. Author

N66-36482*# National Academy of Sciences—National Research Council, Washington, D. C. Space Science Board.
LAUNCH OPPORTUNITIES AND SEASONAL ACTIVITY ON MARS
Carl Sagan (Harvard Univ.), and J. W. Haughey (NASA, Washington) *In its* Biol. and the Exploration of Mars 1966 p 283-291 refs (See N66-36466 22-04) CFSTI: HC $8.27/MF $2.75

The characteristics and restrictions of Martian planetary opportunities during fly-by, orbiter, or lander missions, are discussed; and seasonal activities affecting the utilization of planetary opportunities, are analyzed. S.C.W.

N66-36489*# National Academy of Sciences—National Research Council, Washington, D. C. Space Science Board.
PROSPECTS FOR MANNED MARS MISSIONS
Elliott C. Levinthal (Stanford Univ.) *In its* Biol. and the Exploration of Mars 1966 p 436-442 refs (See N66-36466 22-04) CFSTI: HC $8.27/MF $2.75

Studies called EMPIRE (Early Manned Planetary-Interplanetary Rountrip Expeditions) which were initiated early in 1962 by the Future Projects Office for the Marshall Space Flight Center, and related studies by other NASA centers, were reviewed in an effort to focus on technical problems associated with such missions. Studies on single and multiple planetary fly-bys are emphasized, with some consideration given to planetary orbital and landing missions. The time period considered was the early 1970's. Presented is a survey of the types of missions considered, the time period during which they might occur, a rough estimate of their costs, and their relationship to other NASA programs. S.C.W.

N66-36506# Canaveral Council of Technical Societies, Fla.
THIRD SPACE CONGRESS:, THE CHALLENGE OF SPACE
1966 737 p refs Proc. of the Conf. held at Cocoa Beach, Fla., 7-10 Mar. 1966

Papers on space communication, bioastronautics, ground support, reliability, range instruemntation, management, navigation and control, and reentry and recovery are presented. For individual titles see N66-36507-N66-36562.

N66-36513# Bell Aerosystems Co., Buffalo, N. Y.
COSMOLOGY AND ORGANIC EVOLUTION
Minas Ensanian *In* Canaveral Council of Tech. Soc. 3d Space Congr. 1966 p 95-109 refs (See N66-36506 22-30)

In keeping with the Einstein concept of unified fields, a general cosmological problem (GCP) is proposed which requires not only a physical basis for the unification of gravitation and electromagnetism but the incorporation, as well, of the origin and dynamics of the phenomenón of organic evolution for the case of a living system existing in Opik's oscillating universe. To effect this unification, the assumption must be made that in its final analysis the universe consists of a single entity viz., a subquantum mechanical ether referred to as "cosmic entropy" and all events in the physical universe constitute perturbations in the local field of this fundamental continuum or entity. Using a hypothetical model cell, an attempt is made to derive a biophysical analog of the Einstein relation $E=MC^2$ and which under certain boundary conditions reduces to a similar form. One can effect the solution GCP by simply defining the living process as the annihilation of infinitesimal quantities of matter and life as the production of cosmic entropy. Organic evolution therefore is a natural consequence in the effort to increase the efficiency of the conversion process. Author

N66-36514# Cornell Univ., Ithaca, N. Y.
THE ORIGIN OF METEORITES: SPACE EROSION AND COSMIC RADIATION AGES
David E. Fisher *In* Canaveral Council of Tech. Soc. 3d Space Congr. 1966 p 110-122 refs (See N66-36508 22-30)

A reasonable amount of space erosion, due to dust particles in the asteroidal belt, coupled with the fact that there is a high mass cut-off for chondrites at about 1000 kg, is sufficient to explain the absence of chondrites with radiation ages greater than 55×10^6 years. Then if one postulates continuous creation of meteorites by asteroidal collisions, the effect of space erosion is

to shift the measured ages toward lower values and to destroy a certain portion of meteorites as a function of their time in space. The total effect, as estimated with several simple but plausible erosion rates, is to duplicate quite nicely the observed shape of the radiation age spectrum. Thus space erosion is not the sole factor in determining the radiation age of a chondrite, but is a factor which grows in importance as the age increases, becoming the sole factor at 55×10^6 years. The model is in agreement with the postulate of a distinct bronzite producing collision 4 million years ago, whose effect is observed on top of the background of continuous collision. It is therefore suggested that both stone and iron meteorites are created by collisional processes in the asteroidal belt. Author

N66-36515# RAND Corp., Santa Monica, Calif.
A PROGRAM OF ASTRONOMY RESEARCH ON THE MOON AND ITS LOGISTICS IMPLICATIONS
Raoul J. Freeman, Roger C. Moore, and Gerhard F. Schilling *In* Canaveral Council of Tech. Soc. 3d Space Congr. 1966 p 123–136 refs (See N66-36506 22-30)
(Contract AF 49(638)-1700; Proj. RAND)

One aspect of possible post-Apollo space activity—a program of astronomical research on the moon that culminates in the establishment of a lunar observatory—is discussed. A mathematical model is utilized to analyze the logistics implications of conducting such an astronomical research program. The nature of the research equipment needed for the accomplishment of the program is outlined. Super-position of this research program upon a basic long-term lunar-base operations plan tentatively indicates that it could be feasible to conduct such a program of research during the 1970's and 1980's well within the constraints imposed by the logistics of presently planned spacecraft, boosters, and launching facilities. Although the best available numbers were used, the present study is viewed more as an exposition of a methodology than as the establishment of a conclusive result. Author

N66-36516# Northrop Space Labs., Hawthorne, Calif.
A MANNED FLYBY MISSION TO EROS
Eugene A. Smith *In* Canaveral Council of Tech. Soc. 3d Space Congr. 1966 p 137–155 refs (See N66-36506 22-30)

Eros (433), the largest of the known close approach asteroids, will pass within 0.15 AU of the Earth during its 1975 opposition. This close approach, occurring near the asteroid's descending node and perihelion, offers an early opportunity for a relatively low energy manned interplanetary mission. Such a mission could provide data important to the space technologies, to the astrosciences, and to the utilization of extraterrestrial resources. The model mission described satisfies this criterion and can be accomplished by a single uprated Saturn V and derivatives of MORL and Apollo. The model mission includes a 527-day free return flight performed by a 330,000-pound vehicle system. An S-IVB/IU stage injects the spacecraft into a two-day geocentric ellipse where it is erected to its interplanetary configuration. Author

N66-36522# Brevard Engineering Coll., Melbourne, Fla.
PROJECT HIGH WATER—A TEST OF AN ABORT IN SPACE
James A. Lasater and David D. Woodbridge *In* Canaveral Council of Tech. Soc. 3d Space Congr. 1966 p 229–234 refs (See N66-36506 22–30)
(Contract NASw-958)

The Project High Water experiments produced optical, elf, radiofrequency, and radar data essential to understanding the effects of data releases of large quantities of water in the ionosphere. Extensive cross correlations were found between the various frequencies of acquired electromagnetic data. These data were analyzed and a physical model of the expansion process was developed. Results of the analyses demonstrate that: (1) Extremely low temperatures will be generated by the evaporation–condensation–sublimation processes. (2) The maximum velocity of the expanding ice water cloud approximated 1.83 km/sec. (3) Considerable turbulence is associated with the sudden release of liquids into space. (4) Telemetry attenuations can result from inhomogeneous regions within the ionosphere. (5) Considerable doubt was raised concerning the possible existence of ice in space. The attenuation effects were found to be both frequency and directionally sensitive. Author

N66-36544# Martin Co., Cocoa Beach, Fla. Canaveral Div.
RENDEZVOUS LAUNCH OPERATIONS PLANNING
M. J. Goodkind *In* Canaveral Council of Tech. Soc. 3d Space Congr. 1966 p 479–486 ref (See N66-36506 22-30)

The inception and evolution of the simultaneous launch countdown technique is described. Furthermore, the implementation of the countdown and recycle plans and how testing and scheduling of the Gemini Launch Vehicle (GLV) is affected by a rendezvous mission is discussed. Author

N66-36555# Space Technology Labs., Inc., Los Angeles, Calif.
CALIBRATION OF THE IMPACT ERRORS DUE TO G AND G UNCERTAINTIES IN THE MINUTEMAN R AND D TEST PROGRAM AT THE EASTERN TEST RANGE
A. N. Drucher *In* Canaveral Council of Tech. Soc. 3d Space Congr. 1966 p 598–604 (See N66-36506 22-30)

The technique used in the Minuteman program to evaluate the effect on impact of the geodetic and geophysical (G&G) error on a typical Minuteman trajectory is described. It involves measuring the velocity and position vector of the actual missile in flight at both ends of the ballistic free flight trajectory, and individually extending these vectors to impact using the targeted equations of motion. Additonal details are provided and the results of a G&G evaluation flight test using this technique are assessed. H.S.W.

N66-36556# General Electric Co., Philadelphia, Pa.
THE ROLE OF THE CIS-LUNAR LIBRATION POINT IN LUNAR OPERATIONS
W. Raithel *In* Canaveral Council of Tech. Soc. 3d Space Congr. 1966 p 605–610 (See N66-36506 22-30)

The five libration points in the Earth–Moon system are examined, and the advantages which result from the use of the cis–lunar libration point L_1 as the place of departure for descent to the Moon, as the parking place for the Command Module, and as the place of rendezvous after takeoff of the Lunar Landing Vehicle are defined. After determining the magnitude of the force imbalance at the 3-body libration points, and the motions of a spacecraft relative to these points, it is shown that the L_1 position appears to be attractive because it is closest to the Moon; the spacecraft can be kept in the vicinity of L_1 at the cost of less than $\Delta V = 10$ ft/sec/day; the position is well defined and can be determined with sufficient accuracy with state-of-the-art means; and a spacecraft in L_1 is in fixed position to the near side of the Moon. A concept for a trip from the Earth to the Moon is proposed and some advantages of this avenue of approach are given. H.S.W.

N66-36557# General Motors Corp., Milwaukee, Wis. AC Electronics Div.
APPLICATION OF TITAN III GUIDANCE AND NAVIGATION SYSTEM TO LUNAR MISSIONS
Spencer M. Macy *In* Canaveral Council of Tech. Soc. 3d Space Congr. 1966 p 611–620 (See N66-36506 22-30)

This paper discusses the changes which would be required in the present Titan III guidance hardware and software to perform a certain class of lunar missions. The changes considered are those that require minimum modification of the existing operating ground equipment, missile guidance computer ground programs and flight equations. The accuracy of the guidance and navigation

system is of interest to the payload user, since any decrease in the midcourse correction requirements can immediately be translated into an increase in useful payload weight. One of the primary considerations in the discussion of system modifications is that of minimizing system errors. The propagation of system errors and the lunar impact sensitivity coefficients are treated in some detail. Author

N66-36712*# Lockheed Missiles and Space Co., Sunnyvale, Calif.
ZERO-G TESTING OF SATELLITE INSPECTION MECHANISMS
Reinhard Lahde and J. W. Lebold (Lockheed-Calif. Co.) *In* JPL 1st Aerospace Mech. Symp. [1966] 12 p refs (See N66-36691 22-31)
(Contract AF 33(657)-10466)

Methods and means of testing the mechanisms needed in support of docking operations are reported, with emphasis on noncooperative targets. Only ground testing of complete docking systems is considered. A mechanical support system was selected on the basis of technical feasibility combined with flexibility of test applications and dynamic accuracy of testing. Methods for despinning the target using electromagnetic breaking, and for offsetting gravitational forces are mentioned. Concepts for simulating the dynamic motions of the target and chaser by computer control and by natural reaction are described. Details are presented on ground supported and overhead suspended behicle simulators. The desirable characteristics for a versatile docking system validation facility are listed. N.E.N.

N66-36783*# Goodyear Aerospace Corp., Akron, Ohio.
COMPUTER STUDY TO DETERMINE THE EFFECT OF BALLOON FOOTPRINT AND OPTICAL CHARACTERISTICS ON MATERIAL TEMPERATURES OF A SPHERE ON THE LUNAR SURFACE FOR HIGH-NOON CONDITION
Jan. 1966 38 p refs
(Contract NAS1-5778)
(NASA-CR-66166; GER-12577) CFSTI: HC $2.00/MF $0.50 CSCL 22A

An analysis was made to determine the temperature distribution of a 12-foot balloon, with a diffuse surface, sitting on the lunar surface at high noon with two different footprints, 30° and 150°. The optical properties of the external surface were varied through several different values. Both the solar absorptance and total emittance have an appreciable effect on the temperatures. The smaller the footprint and smaller the range of the average temperature for the various emittances. The lunar properties of emittance and absorptance were varied through a range that would cover most published values for maximum lunar surface temperatures, 250° to 270°F. The effects on the balloon temperatures were minor. In general, the use of a rigidized sphere for a lunar landing aid appears very feasible since the footprint is not critical from a thermal standpoint, internal pressurization is not required, and a reflective sphere with a thin coating, which increases the emittance, results in very favorable temperatures for the Mylar. Author

N66-36806*# Rice Univ., Houston, Tex. Dept. of Space Science.
SATELLITE OBSERVATIONS OF PARTICLE FLUXES AND ATMOSPHERIC EMISSIONS
Brian J. O'Brien [1966] 45 p refs Presented at NATO Advanced Study Inst. on Aurora and Airglow, Keele, England, Aug. 1966
(Contracts NAS6-1061; Nonr-4964(1))
(NASA-CR-77908) CFSTI: HC $2.00/MF $0.50 CSCL 03B

CONTENTS:

1. SUMMARY OF RELEVANT PARTICLE MEASUREMENTS MADE FROM SATELLITES B. J. O'Brien 22 p refs (See N66-36807 22-29)

2. SUMMARY OF SATELLITE OBSERVATIONS OF EMISSIONS B. J. O'Brien 17 p refs (See N66-36808 22-30)

N66-36808*# Rice Univ., Houston, Tex. Dept. of Space Science.
SUMMARY OF SATELLITE OBSERVATIONS OF EMISSIONS
In its Satellite Observations of Particle Fluxes and Atmospheric Emissions [1966] 17 p refs (See N66-36806 22-30) CFSTI: HC $2.00/MF $0.50

Preliminary results of airglow studies are presented, and satellite-borne photometric studies are summarized. Simultaneous measurement of atmospheric emissions of auroral light and the particles exciting it are discussed, and relevant measurements from unmanned spacecraft are tabulated. Technical advantages and disadvantages of satellite-borne photometry are listed. It is indicated that the principal results obtained have been for auroral studies rather than for airglow. R.Ll.

N66-36835# Joint Publications Research Service, Washington, D. C.
DEVELOPMENTS IN THE USSR SPACE PROGRAM
29 Aug. 1966 29 p Transl. into ENGLISH from Aviats. i Kosmonavt. (Moscow), no. 7, 1966 p 17-19, 20-24, 28-30 (JPRS-37307; TT-66-33736) CFSTI: $1.00

CONTENTS:

1. AUTOMATION AND TELEMETRY IN SPACE MEDICINE A. Kalinovskiy p 1-6 (See N66-36836 22-07)

2. GENERAL CONCLUSIONS OF LEONOV SPACE WALK Ye. Ivanov, V. Popov, and L. Khachatur'yants p 7-16 (See N66-36837 22-30)

3. STUDY OF LACK OF MAGNETIC FIELD ON MOON V. Lebedev p 17-22 (See N66-36838 22-30)

N66-36837# Joint Publications Research Service, Washington, D. C.
GENERAL CONCLUSIONS OF LEONOV SPACE WALK
Ye. Ivanov, V. Popov, and L. Khachatur'yants *In its* Develop. in the USSR Space Program 29 Aug. 1966 p 7-16 (See N66-36835 2-30) CFSTI: $1.00

The degree of retention of motorial skill and coordination of movement obtained on earth when exiting into space was evaluated on the basis of a comparison of the maximum sppeds and accelerations of movement and also the physical effort exerted during this process. Several slides showing the cosmonaut during the space walk are shown, and movement parameters are given in graphical form. It is noted that the skill and coordination of movement developed during earth and laboratory aircraft training sessions were retained when the cosmonaut exited into open space. A.G.O.

N66-36838# Joint Publications Resesearch Service, Washington, D. C.
STUDY OF LACK OF MAGNETIC FIELD ON MOON
V. Lebedev *In its* Develop. in the USSR Space Program 29 Aug. 1966 p 17-22 (See N66-36835 22-30) CFSTI: $1.00

Lunar exploration effects on the psychophysiological functions of man are investigated. The disruption in movement coordination due to fact that the force of gravity on the moon is one-sixth of that on earth is discussed, and the possible nervous system effects resulting from the lack of a lunar magnetic field are considered. It is pointed out that experimental research has shown that various electromagnetic fluctuations can affect the nervous system of man and animals, and that the natural earth magnetic field influences behavior in man to some degree, but not as significantly as in the lower animals. A.G.O.

N66-36843# Stanford Univ., Calif. Dept. of Aeronautics and Astronautics.
MINIMUM FUEL TRANSFERS BETWEEN COAXIAL ELLIPSES, BOTH COPLANAR AND NONCOPLANAR

Colman Byron Winn Aug. 1965 38 p refs
(Contract AF 33(615)-1411)
(SUDAAR-243; AFAL-TR-65-276; AD-635684) CFSTI: HC $2.00/MF $0.50

This report presents the solutions for the minimum fuel transfers between coaxial ellipses, both coplanar and non-coplanar. These problems are unusual in that the optimal solutions can be obtained analytically. This report merely presents some of the results that have been obtained; the derivations and proofs have been omitted. Author (TAB)

N66-36851*# National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.

EVALUATION OF A NEW METHOD OF INTEGRATING THE ORBITAL EQUATIONS OF MOTION FOR USE IN SPACE NAVIGATION

John D. Mc Lean Washington, NASA, Sep. 1966 59 p refs
(NASA-TN-D-3624) CFSTI: HC $2.50/MF $0.75 CSCL 22C

The applicability of a new method of integrating the orbital equations of motion to the problem of space navigation is investigated. The investigation is carried out by means of a digital computer program written for the method. The transearth and translunar phases of a circumlunar trajectory are taken as sample problems, but the method can also be applied to any orbital mission. The gravitational effects of the sun, moon, earth, and earth's oblateness are considered. A detailed description of the computer program, including listings, is presented. Data show the effects of various error sources and the trade off between computing speed and accuracy. The method is compared with Cowell's method on the basis of computer storage, integration time, and accuracy. Author

N66-36861# Auburn Univ., Ala.

ON THE EFFECT OF AN OBLATE ATMOSPHERE ON THE SATELLITE DECELERATION EQUATIONS

Theodore Carlton Gerst (M.S. Thesis) 24 Aug. 1966 63 p refs
(Contract AF 33(608)-1207)
(AD-635235) CFSTI: HC $1.50/MF $0.75

This paper deals with the development of relationship between the semimajor axis and the revolution number of a close earth satellite in the presence of atmospheric drag. The atmospheric density is represented by a power function with an integer exponent. The power function is modified to take account of atmospheric oblateness. A relationship is first derived between the semimajor axis and the revolution number for a spherically symmetrical atmosphere. This relation is used as a core solution and a procedure is outlined for extending the solution to include the effects of atmospheric oblateness. Thee effects are treated as perturbations of the core solution. The perturbing terms are developed analytically as functions of a single variable. Several approximations are suggested for use in further development of the theory. Author (TAB)

N66-36864# Stanford Univ., Calif. Dept. of Aeronautics and Astronautics.

DIRECT DETERMINATION OF SATELLITE COORDINATE PERTURBATIONS BY THE VON ZEIPEL METHOD

Juris Vagners Nov. 1965 41 p refs
(Contract AF 33(615)-1411)
(SUDAER-252; AFAL-TR-66-196; AD-635685) CFSTI: HC $2.00/MF $0.50

By utilizing the canonical variables (R, G, H, R, U, H) of Hill, the in-plane variations in a satellite's coordinates are obtained in a simple manner from the conventional generating functions of the von Zeipel procedure. The generating functions are extended and convenient expressions are found for the radius, radial velocity and the central angle, taking into account the first-order periodic influences of any harmonic in the expansion for the earth's gravitational field. These expressions are non-singular for zero eccentricity orbits but do not apply for zero inclination orbits, orbits at critical inclination nor for orbits in a state or resonance with the tesseral harmonics. Author (TAB)

N66-36883# Ritchie and Associates, Inc., Dayton, Ohio.

PREDICTOR DISPLAY TECHNIQUES FOR ON-BOARD TRAJECTORY OPTIMIZATION OF RENDEZVOUS MANEUVERS Final Report, Dec. 1964–Nov. 1965

William K. Mc Coy, Jr. and George G. Frost (Aerospace Med. Res. Labs.) Wright-Patterson AFB, Ohio, AMRL, May 1966 52 p ref
(Contract AF 33(615)-2353)
(AMRL-TR-66-60; AD-635918) CFSTI: HC $3.00/MF $0.50

Predictor displays for orbital rendezvous present to the pilot target position, interceptor position, and a continuous prediction of the interceptor trajectory relative to the target. Two experiments using rendezvous predictor displays are reported: (1) a comparison of on-line and off-line predictor techniques, and (2) a comparison of intermittent versus continuous updating of the prediction. All conditions tested yielded successful rendezvous performance. Off-line prediction, where the pilot could, at will, interrogate the predictor without expending fuel, was demonstrated to be significantly better than on-line prediction where the pilot could see only his actual predicted path. Intermittent updating produced no significant degradation of performance with update rates as low as once per 50 seconds. Author

N66-36942# Observatoire de Paris (France). Section d'Astrophysique.

POLARIMETRIC STUDY OF THE PLANET MARS Final Scientific Report

Audouin Dollfus and John H. Focas 30 Apr. 1966 61 p refs
(Contract AF 61(052)-508)
(AFCRL-66-492; AD-635928) CFSTI: HC $3.00/MF $0.75

Analysis was made of five thousand two hundred measures of the polarized light of Mars, collected during the last nine apparitions of this planet, since 1948. The polarization curves for the bright and the dark areas of the planet are reproduced for each one of the apparitions. The variation of the polarization for the spectral range 1.05 to 0.45 micron is examined. A polarimetric and photometric study of selected samples of minerals indicated the presence, in the bright areas of the planet, of a fine powder of hydrated iron oxide of the limonite type. The seasonal variation of the polarizing properties of the dark areas of Mars follows closely the variation of their darkness at Martian spring; this suggests a seasonal modification of their microscopic contexture. The luminance of the atmosphere of the planet amounts, for a wavelength of 0.61 micron, to K_a (0.61 Micron) = 0.0006 stilb/phot; this corresponds to a surface pressure of 30 millibars. The scattering coefficient of the atmosphere at 0.47 micron is K_a(0.47 micron) = 0.00151 stilb/phot. This value shows that the atmosphere of the planet is much too transparent in the blue to mask the markings of the soil. Author

N66-37037*# National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.

ON THE USE OF EULER'S THEOREM ON ROTATIONS FOR THE SYNTHESIS OF ATTITUDE CONTROL SYSTEMS

George Meyer Washington, NASA, Sep. 1966 37 p refs
(NASA-TN-D-3643) CFSTI: HC $2.00/MF $0.50 CSCL 22A

The problem of controlling the rotational position (attitude) of a rigid body in three dimensions is discussed. Several control laws are synthesized for the six-dimensional nonlinear control problem by means of some well-known techniques of classical mechanics. The system input, output, and error are represented by 3×3 orthogonal matrices. Euler's theorem on rotations is employed to express the error matrix in terms of the angle of rotation and the direction cosines of the real eigenvector of the error matrix. It is noted that the angle of rotation is a convenient scalar representation of the system error. A class of control laws for

which the control torque is a function of the real eigenvector of the error matrix and the angular velocity of the controlled body is synthesized. Conditions are stated for which the system governed by such control laws is asymptotically stable everywhere. The results are illustrated with three examples: reaction jet control, reaction wheel control, and reaction wheel control with bounded motor torque and speed. Author

N66-37047*# National Aeronautics and Space Administration. Marshall Space Flight Center, Huntsville, Ala.

LUNAR THERMAL ENVIRONMENT

James K. Harrison, Daniel W. Gates, James R. Watkins, and Billy P. Jones 26 Aug. 1966 97 p refs

(NASA-TM-X-53499) CFSTI: HC $2.50/MF $0.75 CSCL 03B

This report provides current quantitative data on photometric, light polarization, luminescence, color, microwave temperature, and infrared temperature properties of the moon. No theoretical models or deductions from them are included; only selected experimental data obtained from measurements made from earth are included. Author

N66-37120# Israel Academy of Sciences and Humanities, Jerusalem.

REPORT ON SPACE ACTIVITIES 1965–66

Apr. 1966 24 p

CFSTI: $1.00/MF $0.50

Presented are brief reports on space research activities at the Hebrew University of Jerusalem; the National Physical Laboratory of Israel and the National Council for Research and Development; the Israel Institute of Technology, Haifa; the Weizmann Institute of Science, Rehovoth; the Tel-Aviv University; and the National Committee for Space Research Radio Observatory, Haifa. Studies pertain to meteorology, experimental physics, chemistry, aeronautical engineering, nuclear sciences, biology, biochemistry, mathematics, etc. G.G.

N66-37122*# Lockheed Missiles and Space Co., Palo Alto, Calif.

SPHERICAL PARTICLE TERMINAL VELOCITIES IN THE MARTIAN DAYTIME ATMOSPHERE FROM 0 TO 50 KILOMETERS

Albert D. Anderson Sep. 1966 37 p refs

(LMSC-6-76-66-21) CSCL 03B

The terminal velocities of spherical particles (density=3.0 gm cm^{-3}), with diameters from one to 10,000 microns, are presented for seven Martian daytime model atmospheres from 0 to 50 km. The model atmospheres are based on results from the Mariner IV occultation experiment which gave densities in the Martian atmosphere that were much lower than previous estimates. The following conclusions are reached concerning the yellow (dust) clouds: (1) The vertical velocities required to keep yellow-cloud particles of sizes 10 μ or less aloft are greater on Mars than on earth; (2) The minimum size of the grains primarily responsible for the local surface yellow-cloud obscurations is about 20 microns. (3) Particles as small as 3 microns could be responsible for the rarer planet-wide obscurations lasting a month or more. It is concluded that the tops of the dust clouds normally extend to the tropopause (5–9 km), which usually limits the convection in the Martian atmosphere. Author

N66-37136*# Israel Program for Scientific Translations, Ltd., Jerusalem.

BIBLIOGRAPHY OF THE PRINTED AND MANUSCRIPT WORKS OF K. E. TSIOLKOVSKII ON ROCKETRY AND SPACE FLIGHT

B. N. Vorob'ev, S. A. Sokolova, and N. I. Rogacheva *In its* Soviet Rocketry 1966 p 193–202 refs (See N66-37126 22-28)

CFSTI: HC $3.75/MF $1.25

Russian and English titles are presented in this annotated bibliography covering 143 publications and manuscripts. An explanatory list of Russian abbreviations is included. M.G.J.

N66-37141*# National Aeronautics and Space Administration, Lewis Research Center, Cleveland, Ohio.

INTERCEPT MISSIONS TO ASTEROID EROS IN 1974 AND COMET D'ARREST IN 1976

Tim J. Kreiter Washington, NASA, Oct. 1966 21 p refs

(NASA-TM-X-1288) CFSTI: HC $1.00/MF $0.50 CSCL 22C

Intercept trajectories to asteroid Eros and comet D'arrest were investigated using a three-dimensional, patched conic, analysis technique. Launch intervals and launch windows are established for trajectories encountering Eros and D'arrest at their perihelia. These trajectories exhibit near-minimum injection energy requirement inasmuch as the perihelia of Eros and D'arrest lie very nearly in the ecliptic plane. Geocentric and heliocentric trajectory parameters are presented graphically, and the payload capabilities of three launch vehicles (SLV-3A/Agena, SLV-3C/Kick, and SLV-3C/Centaur) are given for these opportunities. Author

N66-37158# Smithsonian Astrophysical Observatory, Cambridge, Mass.

ANALYSIS OF F AND G SUBDWARFS. I: THE LOCATION OF SUBDWARFS IN THE THEORETICAL H-R DIAGRAM

S. E. Strom, J. G. Cohen, and K. M. Strom Jul. 1966 33 p refs

Spectrum scans and model stellar atmospheres have been used to locate in the ($L/L_{\odot}$, T_{eff}) plane F and G subdwarfs having known parallax. A comparison is made between their position on the H-R diagram and the evolutionary tracks for population-II models of low- and high-helium content recently computed. The lower helium-content models are found to give somewhat more plausible ages than the high-helium models. Nevertheless, for both the low- and high-helium content models, we find several subdwarfs with ages apparently greater than 10×10 years. Author

N66-37214*# Stanford Univ., Calif. Radioscience Lab.

THE ATMOSPHERE OF MARS: A COMPARISON OF DIFFERENT MODEL STUDIES BASED ON MARINER IV OCCULTATION DATA Scientific Reports 16 and 3

Gunnar Fjeldbo, Wencke C. Fjeldbo, and Von R. Eshleman Jun. 1966 24 p refs

(Contract NgR-05-020-065; Grant NsG-377)

(NASA-CR-78134; SEL-66-054) CFSTI: HC $1.00/MF $0.50 CSCL 03B

Three models for the atmosphere of Mars are compared. In the F_2 models, CO^2 is dissociated by solar ultraviolet radiation at 70 km altitude, and atomic oxygen predominates above 80 km. The principal ion in the daytime ionospheric layer would be O^+, and the topside of the layer would be isothermal at 90°K. The mesopause temperature minimum would be at or below the freezing point of CO_2, and dry ice particles would form. In the F_1 models, molecular constituents predominate in the upper atmosphere to 225 km, and molecular ions formed by solar ultraviolet radiation and various chemical reactions would make up the ionospheric layers. The temperature in the isothermal height region would be between 150° and 250°K. In the E model the main ionization layer is formed by solar X-rays in a mixed upper atmosphere. The mass density in the upper atomosphere for the E model would be more than two orders of magnitude larger than for the F_1 models, and about 10^4 times the mass density at the same altitudes in the F_2 models. The F_2 models fit theory and observation best, and identify the reaction which is critical in defining a particular F_2 model. However, an F_1 model might

result if photodissociation and diffusive separation are markedly less than would be expected by analogy with the earth's upper atmosphere. Author

N66-37220*# General Precision, Inc., Little Falls, N. J. Mathematics Dept.
STUDY OF REDUCED PROBLEMS OF THREE AND FOUR BODIES IN CONNECTION WITH CISLUNAR TRAJECTORIES Final Report, Apr. 1965–Apr. 1966
Apr. 1966 14 p refs
(Contract NAS5-9169)
(NASA-CR-78252) CFSTI: HC $1.00/MF $0.50 CSCL 22C

An effort was begun to apply the Birkhoff rate of growth concept to study motion near periodic trajectories of time dependent Hamiltonian systems. New qualitative information can thus be obtained about motion in the reduced or elliptical three body problem as well as in more general Hamiltonian systems. The preliminary analysis is discussed in detail and shows that by a combination of algebraic manipulation involving polynomials whose coefficients are periodic and by integrating linear equations, useful information can be obtained about solutions near critical points of nonlinear Hamiltonian systems. R.N.A.

N66-37376*# Naval Research Lab., Washington, D. C. E. O. Hulburt Center for Space Research.
RECENT EXTREME ULTRAVIOLET SOLAR SPECTRA AND SPECTROHELIOGRAMS
W. E. Austin, J. D. Purcell, C. B. Snider, R. Tousey, and K. G. Widing [1966] 20 p refs Presented at the COSPAR Meeting, Vienna, 10–19 May 1966 Submitted for Publication
(NASA Order R-09-029-036)
(NASA-CR-78162) CFSTI: HC $1.00/MF $0.50 CSCL 03B

Extreme ultraviolet spectroheliograms obtained on October 20, 1965, February 1, 1966, and with 10" spatial resolution on April 28, 1966, show that the chromospheric coarse mottling and network are characteristic of He II 304 Å; high chromospheric lines such as Mg IX 368 Å are emitted mostly from the limb and plages; coronal lines like those from Fe XV and XVI come only from plages and the corona above them. Spectra obtained on February 1, 1966 show that Fe XV 284 Å and Fe XVI 335, 361 Å are of low intensity in the quiet sun, by comparison to September 20, 1963 when the sun was active. In the new spectrum all three lines of Fe XIV $3p^2P^0$ - $3d^2D$ are resolved, but the identification of Fe XIV $3s^2P^0$ - $3p^2P$ remains questionable. The range 70–105 Å was photographed using a filter of indium instead of aluminum. Many new lines are present, including lines of Fe IX, X, and XI. Author

N66-37424# Joint Publications Research Service, Washington, D. C.
SOVIET-BLOC RESEARCH IN GEOPHYSICS, ASTRONOMY, AND SPACE
19 Sep. 1966 91 p refs Transl. into ENGLISH from the Publ. of the Sino–Soviet Bloc Countries
(JPRS-37710; TT-66-11147-139) CFSTI: $3.00

A compilation of abstracts, summaries, and occasional full article translations is presented on the subjects of astronomy, meteorology, oceanography, terrestrial geophysics, and upper atmosphere and space research. C.T.C.

N66-37432# Minnesota Univ., Minneapolis. The Observatory.
PROPER MOTION SURVEY WITH THE FORTY-EIGHT INCH SCHMIDT TELESCOPE. IX: SIX REGIONS IN THE HYADES
Willem J. Luyten 1 May 1966 24 p ref
(Contract Nonr-5060(00))
(AD-635958) CFSTI: HC $1.00/MF $0.50

In continuation of the three regions in the Hyades reported on in No. V of this series data are given for 1617 proper motion stars found in six more pairs of plates taken with the forty-eight inch Schmidt telescope on regions in the Hyades. Two of these regions—P 357 and P 414—were among the very earliest examined and data on the motions of some 350 stars found in them were published in Vol. III, No. 11 of the Publications of the Observatory of The University of Minnesota. In order to have all the data on the entire region of the Hyades conveniently available in the publication of the present series they are again given herewith. Author (TAB)

N66-37462# Aeronautical Chart and Information Center, St. Louis, Mo. Linguistic Section.
EQUATIONS OF THE MOTION OF AN EARTH'S SATELLITE, TAKING INTO ACCOUNT ATMOSPHERIC RESISTANCE [URAVNENIYA DVIZHENIYA SPUTNIKA ZEMLI S UCHETOM SOPROTIVLENIYA ATMOSPHERY]
K. G. Valeyev Jul. 1966 10 p refs Transl. into ENGLISH from Prikl. Mat. i Mekh. (Moscow), v. 29, Issue 6, 1965 p 100–104
(ACIC-TC-1085; TT-66-61778; AD-635575) CFSTI: HC $3.00/MF $0.50

Translation of Russian Research: equations of the motion of an earth's satellite, taking into account atmospheric resistance. TAB

N66-37469# Royal Inst. of Tech., Stockholm (Sweden). Div. of Plasma Physics.
ON THE ORIGIN OF THE MOON
H. Alfvén 18 Apr. 1966 11 p refs Presented at Symp. on the Mantles of the Earth and Terrestrial Planets, Newcastle, England, 30 Mar.–7 Apr. 1965
(Rept.-66-12) CFSTI: HC $1.00/MF $0.50

The theory of the origin and evolution of the Moon is part of the general problem of the formation of all celestial bodies in our solar system. The principal features of this theory are rapidly reviewed: cosmogonic processes, mass distribution, production of secondary bodies, parameters, etc. Various assumptions concerning the formation of double planets, such as Neptune-Triton and Earth-Moon system, similar in some aspects, are listed. The theory of capture in a retrograde orbit is only applied to the cosmogony of Triton. Gestenkorn's calculations removed the difficulty to this cosmogonic theory, constituted by the direct sense of the present Moon's orbit. As an interesting result he arrived to the conclusion that the minimum distance of the Moon was very close to the Roche limit, however a further detailed study is necessary. ESRO

N66-37480# European Space Research Organization, Paris (France).
ATTITUDE CONTROL: NOTATION, AXIS SYSTEMS, TRANSFORMATIONS, AND RIGID BODY DYNAMICS
W. G. Hughes (RAE, Farnborough) Apr. 1966 43 p refs Lecture given at ESRO Summer School, Oxford, 14 Aug. 1964
(ESRO-TM-27) CFSTI: HC $2.00/MF $0.50

Rigid body kinematics and dynamics are discussed in relation to satellite attitude control problems. Questions of systems of axes, axis transformations, and angular velocities are considered, attention being given to ways of expressing axis transformations in forms suitable for computation. Equations of motion are developed for systems of pivoted rigid bodies, with discussion of the simplifications which can often be used. The free motion of a rigid body is then treated and finally equations are developed for small displacements of a rigid body relative to an earth-pointing axis system. Author (ESRO)

N66-37482# Royal Inst. of Tech., Stockholm (Sweden). Div. of Plasma Physics.

ANTIMATTER AND THE FORMATION OF GALAXIES

A. Elvius and H. Alfven 8 Mar. 1966 10 p refs

(Rept.-66-05) CFSTI: HC $1.00/MF $0.50

Klein's theory of the metagalactic system based on symmetry of matter and antimatter is further developed. Two new processes are considered: that of separation of the original ambiplasma into matter and antimatter and condensation of the homogeneous medium to a great number of galaxies. The time sequence of both these processes determines the matter the galaxy consists of. This report deals essentially with the formation of galaxies preceding the above mentioned separation for which, however, no process has been proposed so far to provoke an efficient separation on a galactic scale. Protogalaxies are assumed to be formed as concentrations in the unseparated ambiplasma at the turning of the metagalactic contraction into expansion or some time afterwards. The possible consequences of the presence in the same galaxy of both matter and antimatter in the form of stars and cells with cloud complexes are presented at the end of this paper. ESRO

N66-37492# European Space Research Organization, Paris (France).

THEORETICAL ASPECTS OF CELESTIAL GAMMA RAYS

R. Luest (Max-Planck-Inst. fuer Physik und Astrophysik) May 1966 19 p refs Lecture given at ESRO Summer School, Alpbach, Austria, 20 Jul.–12 Aug. 1965

(ESRO-SM-60) CFSTI: HC $1.00/MF $0.50

In the introduction the implications of gamma-ray astronomy for astrophysics in general are mentioned. The main part of the lecture deals with the various mechanisms for the production and absorption of gamma-rays in stars and the interstellar medium. Finally, the predicted flux values of celestial gamma-rays, both isotropic and due to discrete sources, are presented. Author (ESRO)

N66-37493# European Space Research Organization, Paris (France).

THEORETICAL ASPECTS OF STELLAR ULTRAVIOLET RADIATION

Anne B. Underhill (Utrecht Univ.) Feb. 1966 17 p Lecture given at ESRO Summer School, Alpbach, Austria, 21 Jul. 1965

(ESRO-SM-52) CFSTI: HC $1.00/MF $0.50

The theory of stellar atmospheres is reviewed. The most important characteristic quantities appearing in the computation of a model atmosphere are discussed. The basic equations used for these calculations are briefly derived. The treatment is then applied to derive the UV spectrum of early stars. The results of specific calculations are compared with observational data. Author (ESRO)

N66-37494# European Space Research Organization, Paris (France).

ULTRAVIOLET ASTRONOMY: OBSERVATIONAL ASPECTS

R. Wilson (Culham Lab.) May 1966 29 p refs Lecture given at ESRO Summer School, Alpbach, Austria, 28 Jul. 1965

(ESRO-SM-53) CFSTI: HC $2.00/MF $0.50

The scope of uv astronomy with satellite- and sounding rocket-borne telescopes is described. After a general review of the major astrophysical phenomena the conclusion is drawn that space astronomy should cover the whole wavelength range 912-3000Å. A survey of the instrumentation includes telescopes, spectrometers and detectors. Astronomical observations which have been carried out so far from space vehicles are reviewed. A short assessment of the relative merits of satellite observations vs sounding rocket observations is presented. Author (ESRO)

N66-37500# Royal Inst. of Tech., Stockholm (Sweden). Div. of Plasma Physics.

ROTATION OF PLANETS

H. Alfven 18 May 1966 12 p refs Presented at Symp. on the Mantles of the Earth and Terrestrial Planets, Newcastle, England, 30 Mar.– 7 Apr. 1966

(Rept.-66-13) CFSTI: HC $1.00/MF $0.50

The periods of axial rotation of 27 asteroids were measured and compared with planetary observations. The axial rotation was found to be the same for a number of celestial bodies varying in mass. Concerning the mechanism producing the equality of the axial periods, some essential conclusions can be drawn such as: the isochronism must be of cosmogonic origin, the braking of the axial rotation of the bodies has not been very significant since their agglomeration, the asteroids cannot derive from a broken-up planet etc. Processes of formation of celestial bodies in the solar system, that of condensation of part of the plasma into grains are discussed, and a theory of agglomeration with rotational periods independent of both mass of body and rotational velocity of the said plasma is laid down. ESRO

N66-37502# European Space Research Organization, Paris (France).

MAGNETIC FIELD MEASUREMENTS IN INTERPLANETARY SPACE

S. Cantarano and F. Mariani (Rome Univ.) May 1966 86 p refs

(ESRO-SR-4) CFSTI: HC $3.00/MF $0.75

Following a short introduction concerning magnetic fields, in general, a survey of space experiments and related theoretical results concerning the magnetic fields of interplanetary medium is made and the experimental techniques involved in the measurement of these fields are given. Author (ESRO)

N66-37506# European Space Research Organization, Paris (France).

GRAVITATIONAL COLLAPSE AND SCALAR INTERACTION IN SUPERDENSE MATTER

F. Pacini (Inst. of Astrophys.) Mar. 1966 12 p refs

(ESRO-SN-53) CFSTI: HC $1.00/MF $0.50

The problem of the gravitational collapse is considered for a uniform, spherically-symmetric assembly of particles by assuming that the particles interact via a short-range attractive scalar field. When the particle density exceeds a critical value, states of negative density arise. As a consequence, the collapse of the configuration becomes impossible and the mechanical behavior of the body is identical to that investigated by Hoyle and Narlikar in the framework of the steady-state cosmology. Author (ESRO)

N66-37508# European Space Research Organization, Paris (France).

THE EFFECTS OF THE LAUNCH VEHICLE ON SPACECRAFT DESIGN

J. Vandenkerckhove (European Space Technol. Centre, Noordw IJK) Mar. 1966 27 p refs Lecture given at ESRO Summer School, Oxford, 12 Aug. 1964

(ESRO-TM-25) CFSTI: HC $2.00/MF $0.50

Deals with the constraints imposed by the launch vehicle on spacecraft design, e.g. on orbit, dimensions, and kinematics. The influence of injection errors is treated mathematically, and the relation between orbital and injection erros is expressed as a propagation matrix. The statistical behavior of the parameters is discussed in some detail. Numerical values of injection errors for Scout are given. A discussion follows on kinematic constraints with spin-stabilized and with actively stabilized upper stages, and on the method of separation between the last stage and the payload. The way in which the dimensional constraints on spacecraft design depend on the launch vehicle and the mission requirements

is illustrated by examples. Finally a brief mention is made of environmental constraints, i.e. what conditions the spacecraft should be capable of withstanding. Author (ESRO)

N66-37544*# Lincoln Lab., Mass. Inst. of Tech., Lexington.
RADAR STUDIES OF THE MOON Quarterly Progress Report No. 3, 1 May–31 Jul. 1966 19 Sep. 1966 42 p refs
(Contract NSR-22-009-106)
(NASA-CR-78370) CFSTI: HC $2.00/MF $0.50 CSCL 03B

Section I is concerned with the observational results of an exhaustive study of the mean depolarizing properties of the lunar surface at 23 cm. It also contains the results of a determination of the angular scattering law of the moon at 3.8 cm, as well as the results of measuring the dependence of the scattering characteristics of the surface on the linear polarization of the scattering at that wavelength. Section II relates in part to the progress of the mapping program at 3.8 cm and in part to the radar observations at 8 mm. Section III discusses a method of observing the lunar surface whereby the ambiguity inherent in the range-Doppler mappingtechnique can be removed without relying on the resolution of the antenna beam. Author

N66-37548# Arizona Univ., Tucson.
COMMUNICATIONS OF THE LUNAR AND PLANETARY LABORATORY, VOLUME 3, NUMBER 51
1965 66 p refs
(Grant NSF G-24732)

A tabulation is presented of micrometric telescopic measures of double stars. Emphasis is placed on the very close binaries, and on others that passed near periastron. The star positions are referred to the equinox of 1950, with magnitudes given on the Harvard scale. Comparisons were made with the latest available orbits, and dynamical parallaxes were determined. C.T.C.

N66-37557# Royal Observatory, Edinburgh (Scotland).
THE CHEMICAL COMPOSITION OF THE MANGANESE STAR 53 TAURI
B. N. G. Guthrie London, HMSO, 1966 22 p refs *Its* Vol. 5, No. 9, p 181–194 HMSO: 5s 6d

The chemical composition of the atmosphere of 53 Tau is determined by a differential curve-of-growth method with α Lyr as the comparison star. Groups of lines of similar mean excitation and ionisation potentials and wavelengths are used so that the results will not be seriously affected by abnormalities in the structure of 53 Tau. Manganese is overabundant, while iron and magnesium are deficient. Calcium and scandium are also deficient as in metallic-line stars. A consideration of the Balmer lines, the intrinsic colour index $(B - V)_o$, and the CII 4267 and HeI 4471 lines suggests that the structure of 53 Tau is abnormal, possibly due to the presence of a close companion star of lower luminosity. Author

N66-37558# Royal Observatory, Edinburgh (Scotland).
THE CYGNUS II ASSOCIATION. II: THE DISTRIBUTION OF STARS AND INTERSTELLAR MATTER
V. C. Reddish, L. C. Lawrence, and N. M. Pratt 1966 82 p refs *Its* vol. 5, no. 8, p 111–180 HMSO: 16s

Star counts and UBV photometry show that the association contains 3000 stars brighter than $m_v = 20.900$ brighter than $m_{pg} = 21$ and 400 brighter than $B = 16.5$, of which at least 300 are OB stars. The distance is 2.1 kpc, and the shape is elliptical, 29 pc by 17 pc. The total mass is between 1.6×10^4 and 6.3×10^4 suns, with 60% of the mass in obscuring clouds surrounding the stars. The association may be rotating about an axis in the galactic plane with an equatorial speed of 2 to 4 km sec.$^{-1}$. Author

N66-37562*# Northwestern Univ., Evanston, Ill. Dearborn Observatory.
ON THE MASS-LUMINOSITY RELATION FOR GALAXIES
Su-Shu Huang [1965] 8 p refs
(Grant NGR-14-007-041)
(NASA-CR-78384) CFSTI: HC $1.00/MF $0.50 CSCL 03B

The mass-luminosity relation for spiral and irregular galaxies found by Pskovskii and a similar relation between the mass of neutral hydrogen and the luminosity noted here lead to a relation between the total mass and the mass of neutral hydrogen for these galaxies. Several hypotheses have been advanced in order to understand this relation. Author

N66-37567*# Northwestern Univ., Evanston, Ill.
ASTROPHYSICS
[1966] 28 p refs Submitted for Publication
(Grant NGR-14-007-041)
(NASA-CR-78357) CFSTI: HC $2.00/MF $0.50 CSCL 03B

The origin of astrophysics as a branch of science is investigated, and its development as a result of advancements made in other branches of science and technology is investigated. Photometry is discussed as a means of astronomical observation, and spectroscopy is described as the empirical foundation of astrophysics. Stellar spectroscopy and its related fields of line identification, chemical abundance, spectral classification, emission lines, radial velocity, line broadening, the Zeeman effect, and the spectroheliograph are examined. Construction of larger telescopes and observatories is mentioned as a factor in the history of astrophysics. S.P.

N66-37573*# Stanford Univ., Calif. Dept. of Aeronautics and Astronautics.
RIGOROUS ERROR BOUNDS ON POSITION AND VELOCITY IN SATELLITE ORBIT THEORIES
J. V. Breakwell and J. Vagners Jun. 1966 56 p refs
(Grant NsG-133-61)
(NASA-CR-78387; SUDAAR-279) CFSTI: HC $3.00/MF $0.50 CSCL 22C

By utilizing results of Hamiltonian theory and the von Zeipel method for treating artificial satellite orbits, error bounds are derived for a general class of orbits with eccentricity less than one. In order to extend the error bounds for the general axisymmetric problem to time intervals of the order $1/J_2$, the known integral of energy is utilized to calibrate the governing differential equations for the rapidly rotating phase. The non-singular rapid phase in this analysis is taken to be the sum of the mean anomaly, argument of periapsis and the right ascension of the ascending node. A corresponding analysis for the general asymmetric problem (including the tesseral harmonics) is also given. From the general error analysis an algorithm is derived for the computation of the correct initial conditions consistent with the expected accuracy of the theory. Numerical results verifying the conclusions of the theory presented in this paper are also given. Author

N66-37579*# United Aircraft Corp., East Hartford, Conn. Research Labs.
STUDY OF LOW-ACCELERATION SPACE TRANSPORTATION SYSTEMS Summary Report Jul. 1964 – Jun. 1965
R. V. Ragsac Jun. 1966 78 p refs
(Contract NAS8-11309)
(NASA-CR-78312; E-910262-6, Vol. I) CFSTI: HC $3.00/MF $0.75 CSCL 22C

A study was conducted to determine whether a manned Mars mission could be accomplished in the 1980 time period using high and low thrust propulsion systems in combination. The principal objective was to investigate means for minimizing the vehicle mass placed on earth parking orbit. Additional effort was expended to further develop and check the simplified trajectory model for low thrust systems, including calculation of near optimum trajectories for combined high-low acceleration systems. The study philosophy was orientated toward integrating the hybrid thrust flight mode requirements with the operating characteristics of the

powerplant. The hybrid thrust vehicle mission was to deliver a Mars excursion module onto a Martian parking orbit, loiter in the parking orbit for 30 days, rendezvous with the surface exploration team, and return to earth. The major indicator of mission capability was the total vehicle mass required on earth parking orbit as a function of the flight and powerplant parameters and in relation to the payload capability of the Saturn V. Criteria and requirements for the low acceleration propulsion system were determined by establishing desired operating characteristics for the powerplant, and determining the optimum mix of high and low thrust propulsion which minimizes gross vehicle mass. R.N.A.

N66-37584*# Northwestern Univ., Evanston, Ill. Dearborn Observatory.

A THEORY OF THE ORIGIN AND EVOLUTION OF CONTACT BINARIES

Su-Shu Huang [1965] 24 p refs Submitted for Publication (Grant NGR-14-007-041)

(NASA-CR-78338) CFSTI: HC $1.00/MF $0.50 CSCL 03B

It is proposed that the orbital angular momentum of binaries may be dissipated through mass ejection along magnetic lines of force. This brings the separation of two component stars closer and closer, such that in some cases contact binaries, like W UMa systems, may be formed in this way. If the dissipation of angular momentum continues after the two components come into direct contact, the course open for the binary is to transfer mass from the less massive to the more massive component. Three observational results: (1) the mass ratios of the W UMa systems, (2) the negative correlation between the axial rotation and the frequency occurrence of spectroscopic binaries in different clusters and associations, and (3) the stars of hydrogen-poor and helium-rich atmospheres, are discussed in the light of this suggestion. Author

N66-37605*# Northwestern Univ., Evanston, Ill. Dearborn Observatory.

ON THE MASS-LUMINOSITY RELATION FOR SPIRAL GALAXIES

Su-Shu Huang [1965] 8 p refs Submitted for Publication (Grant NGR-14-007-041)

(NASA-CR-72899) CFSTI: HC $1.00/MF $0.50 CSCL 03B

The mass-luminosity relation for spiral and irregular galaxies and a similar relation between the mass of neutral hydrogen and the luminosity noted here lead to a relation between the total mass and the mass of neutral hydrogen for these galaxies. Several hypotheses have been advanced in order to understand this relation. Author

31 SPACE VEHICLES

Includes launch vehicles; manned space capsules; clustered and multistage rockets; satellites; sounding rockets and probes; and operating problems. For basic research see: 30 Space Sciences. For related information see also: 28 Propulsion Systems; and 32 Structural Mechanics.

N66-36483*# National Academy of Sciences—National Research Council, Washington, D. C. Space Science Board.

SPACE VEHICLES FOR PLANETARY MISSIONS

Elliott C. Levinthal (Stanford Univ.) *In its* Biol. and the Exploration of Mars 1966 p 292–322 refs (See N66-36466 22-04) CFSTI: HC $8.27/MF $2.75

The characteristics of space vehicles for planetary exploration are reviewed, together with special conditions that govern their use for Martian investigations. Included are data on the potentialities of the Atlas-Agena, the Atlas-Centaur, Titan IIIC, and the Saturn V launch vehicles. Also reviewed are some of the missions (fly-by, orbiter, lander) that have been planned or studied for each of the possible launch vehicles. S.C.W.

N66-36525# Boeing Co., Cocoa Beach, Fla.

S-IC STAGE INSTRUMENTATION SYSTEMS CHECKOUT AT KSC

J. S. Clements *In* Canaveral Council of Tech. Soc. 3d Space Congr. 1966 p 248–257 (See N66-36506 22-30)

The S-IC instrumentation systems and associated ground support equipment, and the test and checkout methods are described. The testing is reviewed, and the ground support equipment is listed. The airborne and ground measuring systems and their data flow are discussed. Emphasis is given to the telemetry systems description, checkout, and operation. N.E.N.

N66-36527# General Electric Co., Houston, Tex. Apollo Support Dept.

APOLLO SPACECRAFT INTEGRATED CHECKOUT PLANNING

H. C. Goff and J. M. Schabacker *In* Canaveral Council of Tech. Soc. 3d Space Congr. 1966 p 284–300 (See N66-36506 22-30)

The integrated checkout planning activities for the Apollo payloads, command module, service module, and lunar excursion module are reviewed. Examples of reducing time consumed for checkout activities without compromising confidence are presented. The functional categories of checkout planning are identified and described. The plans for the Apollo checkouts with and without the lunar excursion module are summarized. The operations at field sites and space centers are discussed. It is pointed out that the complexity of the checkout activities required to produce the completely checked out space vehicle demonstrates the need for the Apollo spacecraft integrated checkout planning. N.E.N.

N66-36530# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.

THE ARIEL II (UK-2) INTERNATIONAL SATELLITE ENVIRONMENTAL TEST PROGRAM

D. M. Shipley and R. J. Barra, Jr. (Westinghouse Elec. Corp, Baltimore, Md.) *In* Canaveral Council of Tech. Soc. 3d Space Congr. 1966 p 324–331 (See N66-36506 22-30)

An important new aspect of the space sciences is the associated field of reliability. The largest part of this effort on a space flight project is environmental testing. This paper presents, as an example, the successful environmental test program of the International Satellite Ariel II. Several specialized tests and unique techniques were employed to assure the quality necessary to accomplish the spacecraft mission. Valuable background information is provided on the mission, technical description, and launch of Ariel II. Scientists have received data from more than 5000 orbits on: (a) galactic noise in the 0.75 to 3.0 Mc region, (b) the vertical distribution of ozone in the earth's atmosphere, and (c) micrometeoroid density. Author

N66-36531# Martin Co., Cocoa Beach, Fla.

TESTING THE MAN-RATED LAUNCH VEHICLE

Francis X. Carey *In* Canaveral Council of Tech. Soc. 3d Space Congr. 1966 p 332–351 ref (See N66-36506 22-30)

A brief description of the Gemini launch vehicle noting the major differences between it and the Titan II is presented; and a successful test method for the man-rated launch vehicle is proposed. Probability of mission success and crew survival is expressed in terms of reliability of malfunction detection and escape systems. Modifications of the Titan II are discussed for the malfunction detection system, hydraulic system, and flight controls. The various activities involved in pre-launch testing are enumerated; and the pilot safety program prior to launch is discussed. S.P.

N66-36550# General Dynamics/Convair, San Diego, Calif.
PROJECT CENTAUR
John S. Cruzan *In* Canaveral Council of Tech. Soc. 3d Space Congr. 1966 p 533–539 refs (See N66-36506 22-30)

With the development of the Centaur project, one of the earliest problems was to assess the reliability of explosive one-shot devices early in the program, and reassess the reliability estimates in the light of further testing. Three different methods of testing both by attributes and by variables are discussed along with the advantages and disadvantages of each. Author

N66-36552# Pan American World Airways, Inc., Patrick AFB, Fla.
ENVIRONMENTAL PARAMETERS OF AN ABORTED LAUNCH
Cyril N. Golub *In* Canaveral Council of Tech. Soc. 3d Space Congr. 1966 p 547–566 refs (See N66-36506 22–30)
(Contract AF 08(606)-7500)

The knowledge of the behavior of the presure and thermal environments of an aborted launch is a starting point for the engineering design or evaluation of materials, assemblies, or systems which might be exposed to the abort environment and are expected to survive. This paper describes the first known measurement and interpretation of abort data. The occasion was the accidental disintegration of the Atlas-Centaur vehicle at the Cape Kennedy Air Force Station, Florida, on 2 March 1965. Other applications of launch hazards instrumentation are discussed. Author

N66-36691*# Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena.
FIRST AEROSPACE MECHANISMS SYMPOSIUM
[1966] 361 p refs Symp. held Santa Clara, Calif., 19–20 May 1966 Sponsored in part by Santa Clara Univ. and Lockheed Missiles and Space Co.
(Contract NAS7-100)
(NASA-CR-77971) CFSTI: HC $7.00/MF $2.00 CSCL 22B

Symposium papers on space vehicle instrumentation, mechanisms, and operating problems are presented. For individual titles see N66-36692–N66-36717

N66-36692*# General Electric Co., Philadelphia, Pa.
FLIGHT-PROVEN MECHANISMS ON THE NIMBUS WEATHER SATELLITE
S. Charp and S. Drabek *In* JPL 1st Aerospace Mech. Symp. [1966] 26 p (See N66-36691 22-31) CFSTI: HC $7.00/MF $2.00

Designs and performance of the mechanical devices and subsystems are discussed. They are divided into groups of sealed or unsealed components, with continuous, single, or repeated operations. Among the conclusions are: (1) Space environment is not severely limiting on the design. (2) Hard vacuum conditions influenced the choice of materials for components and lubricants, primarily as a function of their vaporization and outgassing. (3) The Versilube G-300 silicone grease proved most satisfactory for use with small, unsealed, motorgear drives and for large, slow speed bearings. (4) High energy proton and electron bombardment from the van Allen belt and from solar flares did not prevent the use of any mechanism. (5) Solar ultraviolet and low energy proton and electron bombardment did not influence design except with respect to thermal coatings. N.E.N.

N66-36696*# Lockheed Missiles and Space Co., Sunnyvale, Calif.
NONCONTAMINATING SEPARATION SYSTEMS FOR SPACECRAFT (PROJECT ZIP)
Audley B. Leaman *In* JPL 1st Aerospace Mech. Symp. [1966] 12 p (See N66-36691 22-31) CFSTI: HC $7.00/MF $2.00

The pyromechanical and stressed-skin separation systems for removing the protective shroud and detaching the reentry body, second stage, or spacecraft from the booster are reviewed. Recent improvements in the separation-systems are described, and are based on (1) reducing the required quantity of explosive by charge-shaping instead of by blasting the joints apart, and (2) containing the explosive in a tube and breaking the skin without producing contaminants or fragments. The separation shock and temperature effects are also mentioned. N.E.N.

N66-36698*# McDonnell Aircraft Corp., St. Louis, Mo.
GEMINI/AGENA DOCKING MECHANISM
P. H. Meyer *In* JPL 1st Aerospace Mech. Symp. [1966] 11 p (See N66-36691 22-31) CFSTI: HC $7.00/MF $2.00

The mechanical elements and their operation in the shock attenuation mechanisms, latch mechanism, and the rigidizing mechanism are described. The mechanisms provide for Gemini/Agena engaging, rigidizing, disengaging, and also for repeating the cycle. Schematics accompany the descriptions. N.E.N.

N66-36703*# Lockheed Missiles and Space Co., Sunnyvale, Calif.
COMPRESSION-SPRING SEPARATION MECHANISMS
T. G. Harrington *In* JPL 1st Aerospace Mech. Symp. [1966] 9 p (See N66-36691 22-31) CFSTI: HC $7.00/MF $2.00

The use of compression-spring mechanisms in the separation of spacecraft and shrouds is discussed. Guidelines are laid down whereby the separation restraints can be used to determine the necessity, or lack thereof, of closely guiding the spring. Experience (design, analysis, and flight) is cited to show what can be accomplished by proper design of the mechanisms. Author

N66-36704*# Jet Propulsion Lab., Calif. Inst. of Tech. Pasadena.
MARINER-IV SCIENCE PLATFORM STRUCTURE AND ACTUATOR DESIGN, DEVELOPMENT AND PERFORMANCE
G. Coyle and E. Floyd *In its* 1st Aerospace Mech. Symp. [1966] 13 p (See N66-36691 22-31) CFSTI: HC $7.00/MF $2.00

This report describes the Mariner-IV scan platform and actuator, and the problems encountered in its development. Equipment test results and flight experience are summarized to support the discussion of design adequacy. The scan structure and actuator design are considered to be a reasonable solution within the framework of schedule, structural efficiency, interface definition, and, most important, desired functional objectives. The design techniques and problem areas described are considered to be useful data for application to future spacecraft programs. Author

N66-36711*# Lockheed Missiles and Space Co., Sunnyvale, Calif.
SIMPLIFIED SPACE MECHANISMS USING SUBLIMING SOLIDS
Howard M. Kindsvater *In* JPL 1st Aerospace Mech. Symp. [1966] 12 p refs (See N66-36691 22-31) CFSTI: HC $7.00/MF $2.00

The application of subliming solids as a technique requiring a minimum number of moving parts is investigated and evaluated. Details are presented on energy release mechanisms, flow control devices, timing devices, and force devices. Data is tabulated on the operation requirements, mechanism characteristics, and relative rating for each class of mechanism. It was concluded that subliming solid devices offer advantages for certain types of aerospace uses, and that the devices are highly versatile. N.E.N.

N66-36716*# General Electric Co., Philadelphia, Pa.
DEVELOPMENT OF A PASSIVE DAMPER FOR A GRAVITY-GRADIENT STABILIZED SPACECRAFT
E. J. Buerger *In* JPL 1st Aerospace Mech. Symp. [1966] 14 p (See N66-36691 22-31) CFSTI: HC $7.00/MF $2.00

Gravity-gradient stabilization is possible only if existing oscillatory motions of a spacecraft can be damped out by some form of energy dissipation. Described is the configuration of a component that combines two forms of magnetic, passive damping: an eddy-current damper and a hysteresis damper. These dampers

are so constructed that either one may be engaged, and the other disengaged, upon command. These dampers and the auxiliary components for switching, a unique angle indicator, and a caging device (used during the launch environment) are housed within a single envelope designated as the combination passive damper. Author

N66-36686*# Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena.
MARINER MARS 1964 FLIGHT DYNAMIC DATA
J. E. Randolph 15 Sep. 1966 86 p refs Revision 1
(Contract NAS7-100)
(NASA-CR-78054; JPL-TM-33-278, Rev.1) CFSTI: HC $2.50/MF $0.75 CSCL 22B

Dynamic flight environment of the Mariner Mars 1964 spacecraft are analyzed, and reduced data from Mariner III and Mariner IV are presented and compared. Nine environmental measurements were taken for each spacecraft. These consisted of five vibration transducers within the payload area of each launch vehicle and four microphones mounted outside the vehicle on the launch complex umbilical tower. These telemetered and recorded data have been analyzed by oscillograms, bandpass, power spectra, shock spectra, and data compression. The reduced data are discussed, with references to appropriate analysis techniques. No comparison with ground test data is made. Author

N66-37115*# National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.
TRANSONIC DYNAMIC STABILITY CHARACTERISTICS OF SEVERAL MODELS OF PROJECT MERCURY CAPSULE CONFIGURATIONS
William B. Igoe and Ernest R. Hillje Washington, NASA, Aug. 1961 38 p refs
(NASA-TM-X-554) CFSTI: HC $2.00/MF $0.50 CSCL 22C (Declassified)

The oscillatory characteristics in pitch for 1/9-scale models of three basic configurations and three modified reentry configurations were determined by using a forced-oscillation technique. The oscillatory characteristics in yaw were also determined for the basic reentry configuration. The range of test variables was Mach number from 0.30 to 1.20, angle of attack from 0° to 14°, reduced frequency from 0.0208 to 0.1849, and Reynolds number from 0.55×10^6 to 3.50×10^6. Author

N66-37117*# General Electric Co., Philadelphia, Pa. Missile and Space Div.
GRAVITY GRADIENT STABILIZATION SYSTEM FOR THE APPLICATIONS TECHNOLOGY SATELLITE Eighth Quarterly Progress Report, 1 Apr.–30 Jun. 1966
20 Jul. 1966 97 p *Its* Doc.-66SD4388
(Contract NAS5-9042)
(NASA-CR-78017) CFSTI: HC $3.00/MF $0.75 CSCL 22B

Applications Technology Satellite inversions by means of rod retraction/or extension were completed and the effects of scissor angle on the performance were determined. A pyrotechnically actuated primary boom release system was implemented to provide positive caging during launch and uncaging by means of squibs. Boom element cracking was eliminated successfully by implementing the retrofits, and tests on the combination passive damper were completed. Acceptance tests of the system prototype units were also completed and component qualification tests were started. A summary of these test data is included. G.G.

N66-37133*# Israel Program for Scientific Translations, Ltd., Jerusalem.
THE SCIENTIFIC AND ENGINEERING LEGACY OF F. A. TSANDER [O NAUCHO-TEKHNICHESKOM NASLEDII F. A. TSANDERA]
A. F. Tsander *In its* Soviet Rocketry 1966 p 133–155 refs
(See N66-37126 22-28) CFSTI: HC $3.75/MF $1.25

Based on autographical data and on his published works, material is presented to show the contributions of Tsander to space flight technology. His work on methods of attaining escape velocities and returning to the earth is surveyed, along with theories on liquid propellant rocket engines and rockets. Articles on metallic fuels, dating back to 1909, are reviewed. A proposed scheme of a jet engine and its combination with a gas turbine is illustrated and discussed. His views of spacecraft trajectories are also considered, and figures are included to depict trajectories of flights from Earth to Mars, and from Earth to Venus with corresponding additional and total velocities of the spaceships. M.G.J.

N66-37268*# National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.
PRELIMINARY ANALYTICAL INVESTIGATION OF BOOSTER RECOVERY BY USE OF A HOT-AIR BALLOON FOR BOTH DECELERATION AND FINAL RECOVERY
Stanley H. Scher, James C. Dunavant, and Irene G. Young Washington, NASA, Oct. 1966 43 p refs
(NASA-TN-D-3661) CFSTI: HC $2.00/MF $0.50 CSCL 22C

An analytical investigation has been made of the flight mechanics, aerodynamic heating, and system weight for a booster recovery system in which a single large balloon is used as both a decelerator for reentry and a buoyant device for final recovery. The balloon was assumed to use ram air for maintenance of inflation and to use burners to heat the internal air to provide buoyancy in the atmosphere at low altitude for final recovery. The specific application of the system investigated was for the recovery of the Saturn S-1C booster. The study indicated that a balloon made of conventional glass-fiber cloth, treated by a relatively inexpensive process to provide added heat resistance, could withstand the conditions encountered during both the deceleration and the buoyant phases, and that the deceleration levels were within acceptable levels for the booster. A balloon diameter of 275 feet (84 meters), or possibly less, was adequate for the task, and the total recovery-system weight was of the order of 45,000 to 50,000 pounds (20,412 to 22,680 kilograms). The use of a recovery system of this weight would result in a reduction in mission payload weight of about 3.5 percent. Although the subject recovery system appears feasible from the standpoint of factors studied in this investigation, there are many possible problem areas, particularly in the area of flight mechanics, that would have to be investigated before it could be considered feasible. Author

N66-37269*# Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena.
SURVEYOR MISSION OPERATIONS SYSTEM
4 Apr. 1966 90 p refs
(Contract NAS7-100)
(NASA-CR-78009; JPL-TM-33-264) CFSTI: HC $2.50/MF $0.75 CSCL 22B

The overall objectives of the Surveyor Project are defined, and functional descriptions are given of the four major systems: the launch vehicle, spacecraft, tracking and data acquisition, and mission operations. The principal elements of the Mission Operations System (MOS) are identified in relation to its basic function of controlling the spacecraft through its defined mission activities. Details are given on mission-independent and mission-dependent equipment; the personnel organization for mission direction and technical support is discussed; and the methods used for combining equipment, personnel, and computer programs into a system that will perform in a consistently predictable manner are considered. Also examined are the more advanced technical concepts employed in the command system, whereby virtually all inflight and lunar actions of the spacecraft must be initiated from earth. Three basic types of pre-mission tests conducted to verify that the MOS is ready for a mission are described. A chronology of a typical Surveyor mission is

presented, consisting of an overall view of the communications that take place and the space flight activities controlled by these communications. M.G.J.

N66-37355*# Bureau of Naval Weapons, Washington, D. C.
PROJECT ANNA
Mark M. Macomber *In* NASA, Washington Satellite Geodesy, 1958–1964 1966 p 125–128 Submitted for Publication (See N66-37346 22-13) GPO: HC $0.70; CFSTI: MF $1.25

A brief description of satellite for the U.S. geodetic satellite program, Project Anna, is presented. For range determination, the first ANNA satellite is to contain a transponder that is coupled with ground instrumentation that makes a phase comparison between a modulation frequency as transmitted to and as returned from the satellite. For optical determination of satellite topocentric direction, a high-intensity optical beacon is used. Range rate information is obtained by observing the Doppler shift of ultra-stable transmissions of the satellite. In addition to the geodetic systems instrumentation, the satellite contains various minor experiments that test the environment and the attitude of the satellite. H.S.W.

N66-37361*# Douglas Aircraft Co., Inc., Santa Monica, Calif. Missile and Space Systems Div.
PHASE II STUDY OF HEAD-END STEERING FOR A SIMPLIFIED MANNED SPACE VEHICLE
G. M. Fuller Mar. 1966 372 p refs
(Contract NAS1-5451)
(NASA-CR-66173; SM-51872) CFSTI: HC $7.00/MF $2.00 CSCL 22B

The study of head-end steering for a simplified manned space vehicle was motivated by interest in the reduction of costs and system complexity for manned space operations. The two braod objectives were (1) to refine and optimize the system concept developed and (2) to perform a first order comparison of the improved vehicle with other system concepts in a manner which would isolate the performance and cost effects of steering technique, launch vehicle propulsion, and the spacecraft configuration. The conclusions drawn are grouped according to the three major task areas: vehicle refinement and optimization, system definition, and comparative studies. Author

N66-37409*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
DATA PROCESSING PLAN FOR ORBITING SOLAR OBSERVATORY (OSO-B2)
John H. Schmidt and Joan M. Stockwell Jan. 1965 52 p
(NASA-TM-X-55558; X-545-65-35) CFSTI: HC $2.50/MF $0.50 CSCL 22B

A general description of the structure, mission, and telemetry, and a detailed description of the data handling processing and procedures are presented. The wheel and sail commutators channel assignments are tabulated. The ground data acquisition station operations are described, including the analog tape handling. The production control functions of scheduling for chronological processing, analog-to-digital conversion, and quality control and edit are discussed. N.E.N.

N66-37411*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
INTERPLANETARY MONITORING PLATFORM IMP III–EXPLORER XXVIII Interim Flight Report No. 2
Frank A. Carr Jul. 1966 32 p refs
(NASA-TM-X-55561; X-724-66-354) CFSTI: HC $2.00/MF $0.50 CSCL 22B

The spacecraft fulfilled the mission objective of a one-year lifetime, and at that time completed 62-1/2 orbits and some 10,000 hours of data (including overlapping coverage) were recorded. Operation of the primary spacecraft systems—telemetry, power and data handling—continue to be excellent. Experiment status continues unchanged: specifically, six of the nine are working properly, one partially, and two solar plasma experiments not providing any data. Author

N66-37412*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
THE EFFECT OF ANTENNA LOCATION ON PITCH/ROLL COUPLING CHARACTERISTICS OF THE APACHE
Edward E. Mayo and Mark B. Nolan Aug. 1966 46 p refs
(NASA-TM-X-55562; X-721-66-395) CFSTI: HC $2.00/MF $0.50 CSCL 16D

Data from wind tunnel testing were used in equilibrium solutions and dynamic simulations to assess the effects of forward-mounted quadraloop antennas on the pitch/roll coupling characteristics of the Apache sounding rocket. Test results show that the maximum induced roll moment near resonance for the forward location was approximately twenty times the clean-configuration value. The induced roll-moment coefficient period was determined by the quadraloops rather than by the number of fins (i.e., π instead of $\pi/2$). No degradation to induced roll moment was found when the quadraloops were located in the rearward position. The tests also provided information on the increased loading and loss in stability caused by the antennas. C.T.C.

N66-37476# European Space Research Organization, Paris (France).
ATTITUDE CONTROL: MOMENTUM EXCHANGE CONTROL ACTUATORS
W. G. Hughes (RAE, Farnborough) Apr. 1966 17 p refs Lecture Given at ESRO Summer School, Oxford, 20 Aug. 1964
(ESRO-TM-31) CFSTI: HC $1.00/MF $0.50

The use and advantages of momentum exchange control actuators are first discussed. Equations of motion for wheel and gyro actuators are then derived. Some discussion is given on the main features of reaction wheel characteristics and construction. Author (ESRO)

N66-37477# European Space Research Organization, Paris (France).
ATTITUDE CONTROL: SPIN STABILISATION
W. G. Hughes (RAE, Farnborough) Apr. 1966 18 p refs Lecture Given at ESRO Summer School, Oxford, 24 Aug. 1964
(ESRO-TM-34) CFSTI: HC $ 1.00/MF $0.50

The stability of a spinning body, with the question of nutation damping is investigated. A brief discussion is given of the effects of environmental torques in causing spin-rate reduction and spin-axis precession, and of the possibilities of active control of spin-axis attitude. Author (ESRO)

N66-37478# European Space Research Organization, Paris (France).
ATTITUDE CONTROL: ENVIRONMENTAL TORQUES ON A SATELLITE
W. G. Hughes (RAE, Farnborough) Apr. 1966 18 p refs Lecture Given at ESRO Summer School, Oxford, 17 Aug. 1964
(ESRO-TM-28) CFSTI: HC $1.00/MF $0.50

The torques which a satellite will experience due to the principal environmental disturbances are discussed; these are the earth's atmosphere, the earth's gravitational field, the earth's magnetic field, solar radiation pressure, and meteoroid impact. Author (ESRO)

N66-37479# European Space Research Organization, Paris (France).
ATTITUDE CONTROL: GYROS AS SENSORS
W. G. Hughes (RAE, Farnborough) Apr. 1966 11 p ref Lecture Given at ESRO Summer School, Oxford, 20 Aug. 1964
(ESRO-TM-32) CFSTI: HC $1.00/MF $0.50

Rate gyros and integrating rate gyros are distinguished; the equation for the gimbal motion in each case is derived and the influence of the parameters discussed. The use of gyros in earth-pointing satellites to provide a yaw reference is described. Finally, the main features of gyro construction are reviewed. Author (ESRO)

N66-37510# European Space Research Organization, Paris (France).
ATTITUDE CONTROL: MAGNETIC CONTROL ACTUATORS
W. G. Hughes (RAE, Farnborough Apr. 1966 9 p refs Lecture Given at ESRO Summer School, Oxford, 20 Aug. 1964
(ESRO-TM-30) CFSTI: HC $1.00/MF $0.50

Magnetic torque-producing devices are considered, covering coils for active magnetic control, and the production of de-spin torques via hysteresis in ferromagnetic rods. Author (ESRO)

N66-37534# Watertown Arsenal Labs, Mass. Research and Development Div.
DEVELOPMENT OF MANUFACTURING TECHNIQUES AND FABRICATION OF AMRAD TARGET RE-ENTRY TEST VEHICLES
E. J. Brown and G. W. Driscoll Jan. 1966 37 p Sponsored by ARPA
(Proj. Defender)
(AD-479854)

This report deals with the development of manufacturing techniques, problems encountered and test results obtained in the fabrication of re-entry test vehicles. The AMRAD Target re-entry vehicles were designed to be used in the AMRAD Phase I Measurements Program. This effort was terminated by ARPA prior to flight testing of these RTV's. Author

N66-37589*# North American Aviation, Inc., Downey, Calif. Space and Information Systems Div.
A STUDY OF ELECTRONIC PACKAGES ENVIRONMENTAL CONTROL SYSTEMS AND VEHICLE THERMAL SYSTEMS INTEGRATION Quarterly Report No. 1, May - Jul. 1966
D. J. Watanabe 29 Jul. 1966 88 p
(Contract NAS8-20320)
(NASA-CR-78361; SID-66-1277) CFSTI: HC $3.00/MF $0.75
CSCL 22B

A study is presented on the optimum environmental control systems for thermally conditioning individual electronic packages used in Saturn missions of durations ranging from 4 1/2 hours to 180 days. Efforts were directed at establishing system requirements and constraints, evaluating components and subsystems, and analyzing trade-offs. Essential characteristics of the optimum environmental control systems are maximum practicable reliability and operating range and minimum weight, power, and volume. S.P.

32 STRUCTURAL MECHANICS

Includes structural element design and weight analysis; fatigue; thermal stress; impact phenomena; vibration; flutter; inflatable structures; and structural tests. For related information see also: 17 Materials, Metallic; and 18 Materials, Nonmetallic.

N66-36631# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
ON THE HIGH TEMPERATURE INTERNAL FRICTION DURING LONGITUDINAL VIBRATIONS
S. I. Meshkov and T. D. Shermergor *In its* J. of Appl. Mech. and Tech. Phys. 16 Feb. 1966 p 33-43 refs (See N66-36628 22-23) CFSTI: HC $7.00/MF $1.75

High temperature internal friction, and the boundary value problem of longitudinal vibrations of a uniform isotropic rod are reported. It is shown that the temperature function of the internal friction of such medium gives, during longitudinal vibrations, a relaxation peak and background where the latter increases to infinity, after which the vibrations alternate with an aperiodic process. The solution of the boundary value problem is compared with the calculation of a corresponding rheological model. It is stated that for the region not adjoining the point of transition to aperiodicity the results of both methods coincide, except the region of relaxation peak where the rheological model gives too low a result. R.Li.

N66-36644# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
ON THE CONDITION OF TOTAL PLASTICITY FOR AN AXIALLY SYMMETRIC STATE
D. D. Ivlev and T. N. Martynova *In its* J. of Appl. Mech. and Tech. Phys. 16 Feb. 1966 p 189-194 refs (See N66-36628 22-23) CFSTI: HC $7.00/MF $1.75

Considered are the relationships of the axially symmetric problem of rigid plastic incompressible bodies, when the stress and strain states correspond to the rib of an arbitrary piecewise-linear surface of fluidity interpreting the condtion of plasticity in the space of the principal stresses. It is shown that the problem of determination of stresses is statically determinate. It is stated that results of these investigations can be extended to ideally plastic media whose fluidity conditions depend on the first invariant of stress tensor, and that conditions of Tresca plasticity and maximum given stress limit all possible conditions of fluidity. The solution of axially symmetric problems under the condition of total plasticity can make it possible to find the upper and lower limits of the solutions. R.Li.

N66-36645# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
CONDITION OF DEFORMATION OF A RIGID PLASTIC BODY IN ONE PLANE DURING SEPARATION OF CHIP
V. I. Sadchikov *In its* J. of Appl. Mech. and Tech. Phys. 16 Feb. 1966 p 195-200 refs (See N66-36628 22-23) CFSTI: HC $7.00/MF $1.75

Solutions of the cutting problem on the deformation in one plane of rigid plastic bodies were found to be based on inconsistent premises. Equilibrium equations were used in the solution of problems on an established plastic flow with a discontinuity of field of speeds. An example of the solution to a cutting problem showed that use of these equations is not justified because a consideration of the inertial force radically changed the concept of this problem. R.Li.

N66-36646# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
ADAPTABILITY OF THICK-WALLED PIPES DURING NONUNIFORM HEATING
D. A. Gokhfel'd and P. I. Yermakov *In its* J. of Appl. Mech. and Tech. Phys. 16 Feb. 1966 p 201-207 refs (See N66-36628 22-23) CFSTI: HC $7.00/MF $1.75

The solution of the problem of strength of thick-walled pipes with the repeated effects of internal pressure and high temperature is discussed. A theory of adaptability to the power-machinery engineering and other technological fields is mentioned. By proceeding from the assumption about ideal plasticity, this theory makes it possible to determine the conditions at which repeated loads will not result in a sign-alternating or increasing plastic flow. It is stated that with a limited number of cycles, characteristic for thermocyclic load, the absence of repeated plastic flow can, with a certain approximation, be assumed as a condition of strength. R.Li.

N66-36647# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.

ON THE STABILITY OF AXIALLY COMPRESSED CYLINDRICAL SHELL IN PLASTIC FLOWS

G. V. Ivanov *In its* J. of Appl. Mech. and Tech. Phys. 16 Feb. 1966 p 208–219 refs (See N66-36628 22-23) CFSTI: HC $7.00/MF $1.75

The axisymmetric loss of stability of an axially compressed cylindrical shell is examined. The critical stresses are determined by a certain criterion, except that in the transition from the fundamental to the adjoining state, perturbations causing an unloading are not tolerated. The material is assumed incompressible and its hardening, linear. By the same criterion, critical stresses determined according to the plastic flow theory are somewhat less, but very close to critical. Also mentioned are the problems of plate stability, and stresses determined according to the theory of small elasto-plastic flows. R.Ll.

N66-36648# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.

ON DETERMINING THE DIAGRAM OF COMPRESSION OF LOW-CARBON STEEL IN THE REGION OF ELASTO-PLASTIC DEFORMATIONS

Yu. S. Stepanov *In its* J. of Appl. Mech. and Tech. Phys. 16 Feb. 1966 p 220–232 refs (See N66-26628 22-23) CFSTI: HC $7.00/MF $1.75

Design and testing of the compression of low-carbon steel above the dynamic elastic limit is reported. The design was checked directly by measurement of the kinematic parameters in a passing compressional wave. During deformations a dependence, which obeys the equation of state derived, was calculated. At other values the dependence became nonlinear, which obviously corresponds to the beginning of the formation of shock waves in steel. It was concluded that in the region of elasto-plastic flows within limits $2.38 \cdot 10^{-3} \leq \epsilon_2 \leq 11.93 \cdot 10^{-3}$ low-carbon steel satisfactorily obeys the calculated dependence. This is valid, however, only under the stated assumptions and must be considered approximate. R.Ll.

N66-36693*# Lockheed Missiles and Space Co., Sunnyvale, Calif.

EXTENDIBLE BOOM DEVICE

W. C. Gamble *In* JPL 1st Aerospace Mech. Symp. [1966] 11 p (See N66-36691 22-31) CFSTI: HC $7.00/MF $2.00

The device which forms a beam from three rolls of metal tape, with the metal tape edges joined by Velcro tapes and snap fasteners, is described. Details are given on the boom mechanism, methods of extension and retraction, tape fasteners, and on durability and test results. It is concluded that the boom has the characteristics of strength, dimensional accuracy, and reliability of operation necessary for a spacecraft application. N.E.N.

N66-36694*# Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena.

MARINER-IV STRUCTURAL DAMPERS

Peter T. Lyman *In its* 1st Aerospace Mech. Symp. [1966] 15 p refs (See N66-36691 22-31) CFSTI: HC $7.00/MF $2.00

Structural dampers employed on the Mariner-IV spacecraft were constructed of spring-centered struts consisting of two concentric tubes whose annulus was filled with a very viscuous silicone fluid. From early testing throughout the spacecraft development program these dampers performed without difficulty. Since there were no telemetry measurements which yielded direct performance of the spacecraft structure, satisfactory flight performance by the dampers is inferred from the proper functioning of all Mariner-IV subsystems. Author

N66-36697*# National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.

A VIBRATION ISOLATION MOUNT

Robert E. Reed, Jr. *In* JPL 1st Aerospace Mech. Symp. [1966] 8 p ref (See N66-36691 22-31) CFSTI: HC $7.00/MF $2.00

A vibration mount for low frequency isolation, designed for any allowable stroke length, but limited to an atmospheric environment and a specified load, is described. The mount, which provides a near-zero spring constant while avoiding electronic servo systems, is a piston–cylinder device, in which one side of the piston is subjected to a vacuum and the other side is open to the atmosphere. The piston force is the atmospheric pressure, and the piston therefore provides no restoring force. The test models and test results are described. N.E.N.

N66-36702*# Santa Clara Univ., Calif.

ANALYSIS OF AEROSPACE IMPACT PROBLEMS

D. Hayes, C. Cawood, and T. Kertesz *In* JPL 1st Aerospace Mech. Symp. [1966] 15 p refs (See N66-36691 22-31) CFSTI: HC $7.00/MF $2.00

This paper describes a graphical technique for analyzing the behavior of objects during and after impact. The technique is illustrated by the presentation and experimental verification of an analysis of a particular system. Single impacts with various initial conditions are examined. The analysis is then extended to cover the case of repeated impacts of the same objects. Degeneration of system motion to either a pure central or a pure sliding impact mode is confirmed by both theoretical and experimental results. The existence of a critical angle, which determines the degenerate mode, is established. Author

N66-36707*# Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena.

HIGH-IMPACT RESISTANT MECHANISMS

James L. Adams *In its* 1st Aerospace Mech. Symp. [1966] 9 p (See N66-36691 22-31) CFSTI: HC $7.00/MF $2.00

Investigations performed indicated that a large variety of complex and efficient spacecraft mechanisms can be built to survive impacts on the order of 10,000 g from several hundred fps. Problems associated with ruggedizing such mechanisms are discussed in this paper, and a variety of related design techniques and methods are presented. Several specific mechanisms designed to survive a range of shock environments are described. Results from investigations conducted by other organizations confirm the conclusions. Author

N66-36710*# University of Southern Calif., Los Angeles.

COMPRESSION SPRINGS AT ELEVATED TEMPERATURES

M. J. Siegel *In* JPL 1st Aerospace Mech. Symp. [1966] 16 p (See N66-36691 22-31) CFSTI: HC $7.00/MF $2.00

Cylindrical, helical, compression spring characteristics and equations are discussed. The spring behavior is described for moderate and elevated temperature conditions. The modulus of rigidity was found to decrease linearly with increase of temperature. The increase in strain (creep) and loss of load (relaxation) at high temperatures is discussed with respect to anelastic strain, residual stress relief, transient creep, and steady state creep. Compensation for relaxation in designing is mentioned. N.E.N.

N66-36713*# National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.

A CONCEPT FOR DESIGN OF VARIABLE-VISCOSITY, VARIABLE-STIFFNESS DAMPERS

Jerome J. Lohr *In* JPL 1st Aerospace Mech. Symp. [1966] 14 p refs (See N66-36691 22-31) CFSTI: HC $7.00/MF $2.00

Discussed is a design concept for damping mechanisms which permits an order-of-magnitude increase in damping efficiency compared with that of existing dampers. The concept utilizes polymeric materials at temperatures in the region of their glass transition temperatures. In this region (which may extend over a bandwidth of 10° to 50°C or more), configurational rearrangements of the polymer chain backbones allow very high mechanical energy absorption. Both free- and forced-vibration systems were used to study the properties of mechanical systems employing such dampers. Author

N66-36779# Lockheed Missiles and Space Co., Palo Alto, Calif.
STATISTICAL METHODS IN STRUCTURAL MECHANICS
V. V. Bolotin [1965] 293 p refs Transl. into ENGLISH from RUSSIAN

The application of probability theory and mathematical statistics methods to various problems of structural mechanics and strength is presented. Initial information from probability theory and mathematical statistics are related, and questions associated with investigations of structural reliability and the statistical nature of safety factors are discussed. Modern statistical theories of brittle and fatigue fracture are expounded, and structural stability in the presence of random disturbances are considered. The vibrations of elastic systems subjected to random forces are studied, and the problem of damage accumulation in structures under random loadings is analyzed. An exposition of the statistical theory of seismic stability of structures is also included. A.G.O.

N66-36780# Lockheed Missiles and Space Co., Palo Alto, Calif.
INTERACTION OF UNLOADING AND SHOCK WAVES
A. I. Buravtsev and N. A. Esenina [1966] 13 p refs Transl. into ENLGISH from Vestn. Leningrad Univ. (Leningrad), no. 13, 1966 p 55–63

The elastic–plastic state of a rod which has been loaded for a constant time period and then instantly unloaded is studied. The stress-strain relation during loading is taken in the form of two curves, and the unloading wave is considered linear. The phenomenon of arbitrary discontinuity decay during the collision between the unloading and shock waves is numerically analyzed. The derivation of equations for three cases that are possible, depending on the magnitude of the stress, is shown, and an example which demonstrates the mathematical applications of the interaction is presented. A.G.O.

N66-36829# David Taylor Model Basin, Washington, D. C.
TWO-DIMENSIONAL EXPERIMENTS ON THE EFFECT OF HULL FORM ON HYDRODYNAMIC IMPACT Final Report
Margaret D. Ochi and Frank M. Schwartz May 1966 76 p refs
(DTMB-1994; AD-635783) CFSTI: HC $4.00/MF $0.75

An extensive experimental study was undertaken to evaluate the fundamental parameters affecting the two-dimensional water-entry problem. The effects of ship forebody form, impact velocity, and mass on the magnitudes and time histories of impact pressures were determined and results compared with theoretical predictions. It was found that the theory predicts pressure, force, and impulse that show reasonable agreement with experimental results for sections having fine form, i.e., those of relatively V-form with small flat bottom. However, there is increasing divergence between experimental results and theoretical predictions for relatively blunt forms with large flat bottoms. Author (TAB)

N66-36890# Air Force Systems Command, Foreign Technology Div. Wright-Patterson AFB, Ohio.
APPROXIMATE YIELD CONDITIONS FOR ROTATIONAL SHELLS UNDER AXISYMMETRIC LOADING
Chuh-Sheng Nien 17 May 1966 30 p refs Transl. into ENGLISH from Li Hsueh Hsueh Pao (Peking), v. 7, no. 1, Mar. 1964 p 12–28
(FTD-TT-65-1745; TT-66-61796; AD-635837) CFSTI: HC $2.00/MF $0.50

Translation of Chinese research: approximate yield conditions for rotational shells under axisymmetric loading. TAB

N66-36924# Northrop Corp., Newbury Park, Calif. Applied Research Dept.
SHOCK PROPAGATION IN SOLIDS AND FOAMS AND STUDIES OF NON-HYDRODYNAMIC ATTENTUATION (EXPERIMENTAL DATA TO IMPROVE THEORY) Final Report, 1 Jul. 1965–28 Feb. 1966
D. V. Keller 30 Mar. 1966 149 p refs
(Contract DA-01-021-AMC-90022(Y))
(ARD-66-31R; AD-636271) CFSTI: HC $4.00/MF $1.00

Two problems were studied. These were (1) the Hugoniot equation of state of carbon phenolic with two different initial internal energies and (2) the effectiveness of polyurethane foams in reducing peak pressures induced in plate slap experiments. Measurements were performed on unheated samples of carbon phenolic at 23°C and on preheated samples at 150°C: attenuation rate of shock waves traversing the material and the tension at which the material failed were determined at the two temperatures. In addition several series of experiments were carried out to investigate the phenomenon of non-hydrodynamic attenuation. Author (TAB)

N66-36975# General Electric Co., Schenectady, N. Y. Knolls Atomic Power Lab.
THE VIBRATION RESPONSE OF A CANTILEVERED CYLINDER SURROUNDED BY AN ANNULAR FLUID
R. J. Fritz and E. Kiss 24 Feb. 1966 27 p ref
(Contract W-31-109-ENG-52)
(KAPL-M-6539) CFSTI: HC $2.00/MF $0.50

A theoretical analysis and test results are presented which describe the response to a forced vibration of a cantilever supported cylinder, surrounded by a fluid annulus. The effects of the fluid annulus on natural frequency and displacement of the vibrating system are considered. Author (NSA)

N66-37034*# National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.
AN INVESTIGATION OF SPRAY VELOCITY RESULTING FROM HIGH-VELOCITY PENETRATION OF THIN PLATES BY DISKS
John D. Di Battista Washington, NASA, Sep. 1966 35 p refs
(NASA-TN-D-3618) CFSTI: HC $2.00/MF $0.50 CSCL 20K

An analysis based on one-dimensional shock-wave theory is presented to study the maximum velocity of the spray emanating from the rear surface of a thin meteoroid bumper. A set of experiments was designed to evaluate the analytical results. The targets used were 0.0025-cm-thick 1100 aluminum foil and 0.041-cm-thick 1100 H14 aluminum plate. The projectiles used were made of tungsten and were disk shaped, 0.56 cm in diameter, and either 0.076 cm or 0.038 cm in thickness. The target and projectile dimensions used in the experiments ensured that the one-dimensional assumptions used in the theory were valid. In addition, using a very dense tungsten projectile to impact the aluminum targets produced aluminum spray velocities well in excess of the tungsten projectile velocity. With this technique, the projectile and target materials were clearly differentiable in the spray. The experiments were conducted in the impact velocity range of 0.089 to 0.295 cm/μsec. The ratio of maximum target-material spray velocity to projectile impact velocity is defined and is plotted against projectile impact velocity. The ratio predicted by using the theory agrees well with the experimental results in the range of impact velocities investigated. Representative series of photographs are presented and analyzed for the experiments conducted in both thicknesses of aluminum targets. Author

N66-37036*# National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.
DETERMINATION OF TEMPERATURE AND MATERIAL EFFECTS ON HIGH-VELOCITY IMPACT CRATERS IN ABLATIVE HEAT-SHIELD MATERIALS
Paul E. Tippens and John R. Davidson Washington, NASA, Sep. 1966 24 p refs
(NASA-TN-D-3631) CFSTI: HC $1.00/MF $0.50 CSCL 20K

Phenolic-nylon and elastomeric target materials were struck with 1.59-mm-diameter aluminum spheres traveling at 4 km/s. The ablative materials were tested at temperatures of 144°, 294°, and 422°K in evacuable test fixtures. Observed crater volumes

were so irregular in shape that it was not possible to determine easily the effects of temperature and material independently from measurement error. Therefore, an analysis-of-variance technique was applied to experimental impact data to determine whether differences in material or temperature significantly affect the amount of crater damage. It was found in this investigation that no significant differences among the crater diameters or the penetration depths were attributable to temperature differences. However, both crater depth and diameter were influenced by differences in target materials. Author

N66-37078# Pennsylvania State Univ., University Park. Dept. of Engineering Mechanics.
STRESS CONCENTRATION AROUND SPHERICAL CAVITIES IN STRAIN-GRADIENT DEPENDENT ELASTIC BODIES SUBJECTED TO UNIAXIAL TENSION
Glenn A. Hazen and Yechiel Weitsman Jul. 1966 53 p refs
(Grant Nonr (G)-00040-65)
(TR-4; AD-635802) CFSTI: HC $3.00/MF $0.50

This paper presents an analytical solution to a boundary-value problem in linear elasticity where potential energy depends on strains and strain gradients. The problem considered is that of an infinite medium, containing a spherical cavity, subjected to uniaxial tension at infinity. Special attention is given to the stress concentration factor at the surface of the cavity and to some higher order stress-terms. Results show that the stress concentration factor, which depends on two characteristic lengths as well as on additional material parameters, can exceed the classical value. The hyperstresses are found to represent surface like phenomena; they dimish to zero away from the surface of the cavity. Author (TAB)

N66-37092# Polytechnic Inst. of Brooklyn, N. Y. Dept. of Aerospace Engineering and Applied Mechanics.
SUMMARY OF RESEARCH ON REINFORCED AND UNREINFORCED CYLINDRICAL SHELLS Final Report, 1961–1965
Joseph Kempner Jun. 1965 20 p refs
(Contract Nonr-839(14))
(PIBAL-905; AD-636088) CFSTI: HC $1.00/MF $0.50

The studies briefly summarized in this report stem from the investigation of the transverse strength of submarines performed during the past four years. The work was primarily concerned with static stress and stability analyses of reinforced and unreinforced cylindrical shells. Within this framework linear and nonlinear stress and stabililty analyses were carried out. The summary presents brief abstracts of the material presented in twenty-two distinct reports and publications. TAB

N66-37119*# RAI Research Corp., Long Island City, N. Y.
DEVELOPMENT OF A PROTOTYPE PLASTIC SPACE ERECTABLE SATELLITE Quarterly Report Jun.–Aug. 1966
Vincent F. D'Agostino, Preston Keusch, John Raffo, and Louis Cohen 15 Sep. 1966 46 p refs
(Contract NAS5-3923)
(NASA-CR-78018; RAI-370) CFSTI: HC $2.00/MF $0.50 CSCL 22B

Polyethylene film samples were electrolessly copper plated to 5×10^{-6} inch and 10×10^{-6} inch, respectively, on both sides and their flexural rigidities where then used to calculate the minimum film thickness able to withstand initial buckling at five times solar pressure. The obtained minimum thickness of 1.50 mil with 10×10^{-6} inch of copper plating on both sides resulted in a nonperforated satellite sphere weight of 4295 lbs. Calculations on flexural rigidity-thickness for films plated to 15×10^{-6} inch gave a reduced weight of 1413 lbs for a nonperforated satellite. Initial perforation tests on plated film indicated that resistance increased and flexural rigidity decreased sharply with an open area effect of 30%. Calculations on the amount of film necessary to build the deliverable itmes showed that 2 rolls of films were not enough to complete the deliverable structures. G.G.

N66-37143*# Bolt, Beranek, and Newman, Inc., Cambridge, Mass.
LOW-FREQUENCY NOISE REDUCTION OF SPACECRAFT STRUCTURES
R. H. Lyon, C. W. Dietrich, E. E. Ungar, R. W. Pyle, Jr., and R. E. Apfel Washington, NASA, Sep. 1966 173 p refs
(Contract NAS1-4687)
(NASA-CR-589) CFSTI: HC $3.25/MF $1.25 CSCL 20K

An approach is presented for predicting the low-frequency noise transmission of spacecraft structures on the basis of a series of experimental and theoretical analyses. A conceptual model of low-frequency sound transmission is developed, and acoustic models and experiments for testing some of the concepts are suggested. Classical noise reduction calculations are reviewed, and the major mechanical and acoustical mechanisms that control the transmission of sound pressure in spacecraft at low frequencies are outlined. The theory of pressure transmission in single- and double-walled elastic shells is derived, and the effects of acoustical and structural resonance on noise reduction are studied. The purposes and methods of experimental analysis in sound transmission are discussed, and these methods are implemented in experimental studies of various features of the acoustic and vibrational behavior in axisymmetric shells and spaces. Implications for design including choice of structural geometry and the combatting of resonance effects are also considered. A.G.O.

N66-37155*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
EFFECT OF PROJECTILE SIZE AND MATERIAL ON IMPACT FRACTURE OF WALLS OF LIQUID-FILLED TANKS
C. Robert Morse and Francis S. Stepka Washington, NASA, Sep. 1966 16 p refs
(NASA-TN-D-3627) CFSTI: HC $1.00/MF $0.50 CSCL 20K

High-speed rifles and light-gas guns were used to accelerate projectiles for impact into unpressurized, water-filled tanks having walls of 1/32-inch-thick (0.795-mm-thick) 7075-T6 aluminum. The projectiles were solid spheres of aluminum or steel with diameters of 1/32, 1/16, 1/8, or 7/32 inch (0.795, 1.59, 3.175, or 5.56 mm). The tank walls were impacted with each projectile material and size at velocities from 4530 to 24,300 feet per second (1.38 to 7.41 km/sec). Threshold values of projectile kinetic energy and velocity were determined above which fractures resulted and below which only punctures occurred. For a given projectile material, wall fractures were obtained at lower kinetic energy levels for the smaller diameter projectiles. For projectile diameters greater than 1/16 inch (1.59 mm) aluminum projectiles caused wall fracture at substantially lower kinetic energy levels than did the same diameter steel projectiles; however, the reverse was true for projectile diameters less than 1/16 inch (1.59 mm). The threshold-impact velocity required for wall fracture with steel and aluminum projectiles was found to be inversely proportional to the projectile diameter to about the 0.65 power and 1.15 power, respectively. The threshold-impact kinetic energy resulting in wall fracture with the steel and aluminum projectiles was directly proportional to the projectile diameter to about the 1.7 power and 0.7 power, respectively. Author

N66-37156*# National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.
EXPERIMENTAL AND THEORETICAL RESULTS FOR BUCKLING OF ECCENTRICALLY STIFFENED CYLINDERS

Michael F. Card and Robert M. Jones Washington, NASA, Oct. 1966 25 p refs
(124-11-06-04-23)
(NASA-TN-D-3639) CFSTI: HC $1.00/MF $0.50 CSCL 20K

Results from an experimental and theoretical study of the effect of stiffener eccentricity (one-sidedness) on buckling are reported. In the experimental investigation, axial-compression tests were conducted on twelve longitudinally stiffened cylinders which represent six configurations with internal or external, integral or Z-stiffeners. For certain configurations externally stiffened cylinders were found to carry over twice the load sustained by their internally stiffened counterparts. A solution was obtained by a Galerkin procedure for buckling of clamped, eccentrically stiffened, orthotropic cylinders under axial compression, lateral pressure, or hydrostatic pressure. The experimental results for axially loaded cylinders range from 70 to 95 percent of the corresponding theoretical predictions. However, it is concluded from the comparison that a membrane prebuckled shape is sufficient for assessment of eccentricity effects. Furthermore, comparison of solutions for clamped and simply supported cylinders with the test data and with previous theoretical results reveals that edge clamping has a significant effect. Author

N66-37160# Southwest Research Inst., San Antonio, Tex.
A THEORY FOR NONLINEAR TRANSVERSE VIBRATIONS OF A PARTIALLY FILLED ELASTIC TANK Final Report, Part I
Wen-Hwa Chu and Daniel D. Kana 31 Mar. 1966 72 p refs

A simplified theory has been developed for examining nonlinear transverse vibrations of a partially filled circular cylindrical elastic tank. Linear shell theory was employed with nonlinear loadings arising from the liquid sloshing modes. For transverse (coupled) vibrations, a second order theory for liquid motion seems to be adequate, at lease for qualitative studies. An analog computer solution, based on the analysis which includes only the dominant second order terms, exhibited the same regular and irregular beating phenomena in the unstable domain of the shell response as has been observed in laboratory experiments. Some slight damping had to be introduced into the simplified liquid equations, however, in order to have bounded responses in the unstable region. Author

N66-37170# Naval Construction Research Establishment, Dunfermline (Scotland).
PEGASUS COMPUTER SPECIFICATIONS: ELASTIC ANALYSIS OF ORTHOGONAL GRILLAGES EXCLUDING TORSIONAL EFFECTS
C. S. Smith and J. L. Mc Keeman May 1966 34 p refs
(NCRE/R-520; NSTIC/06189/66; AD-635675) CFSTI: HC $2.00/MF $0.50

The report describes a Pegasus program for calculating the deflections and stresses in flat beam grillages under lateral loading. By confining the analysis to orthogonal grillages and excluding torsional effects, provision was made for anlysing grillages with up to 72 intersections. The effects of shear deflection are included. Author (TAB)

N66-37177# Illinois Univ., Urbana.
ANALYSIS OF CIRCULAR CYLINDRICAL SHELLS CONTAINING RECTANGULAR OPENINGS WITH STIFFENED EDGES
R. E. Pinckert and W. C. Schnobrich Jun. 1966 155 p refs *Its* Civil Eng. Studies, Structural Res. Ser. No. 308
(Contract Nonr-1834(03))
(AD-636187) CFSTI: HC $5.00/MF $1.00

In this study, a discrete element physical analogue model is developed for the analysis of elastic cylindrical shells containing rectangular openings. Reinforcing edge beams about the perimeters of the openings are considered. The model is a rectangular framework of weightless rigid bars connected by deformable nodes. Solutions are found for this network which approximates the shell continuum. The physical properties of the replaced shell are considered concentrated at the nodes. The displacements u, v and w of the shell in the longitudinal, transverse and radial directions, respectively, are defined at the junctions of the rigid bars. Expressions for the membrane forces and bending moments in the shell are given in terms of the displacements. Using the principle of virtual work, equilibrium equations are developed at each node point in terms of the unknown displacements. The resulting set of linear simultaneous equations is solved for these displacements. Forces and moments in the shell can then be obtained from the force-displacement relations. The edge beams which stiffen the shell at the openings are symmetrical in reference to the middle surface of the shell. Edge beam internal torsion, bending moments, and axial forces are taken into account in the equilibrium equations. Numerical results are presented for representative shell problems in which the size and type of the shell, dimensions of the holes, stiffnesses of the edge beams, and types of loading are varied. Author (TAB)

N66-37230# Polytechnic Inst. of Brooklyn, N. Y. Dept. of Aerospace Engineering and Applied Mechanics.
DYNAMIC RESPONSE OF ORTHOTROPIC PLASTIC CYLINDRICAL SHELLS UNDER RADIAL PRESSURES
B. Venkatraman and Sharad A. Patel Mar. 1966 19 p refs
(Contract Nonr-839(40) FBM)
(PIBAL-914; AD-635940) CFSTI: HC $1.00/MF $0.50

The dynamic response of orthotropic circular cylindrical shells subjected to exponentially decaying uniform radial pressures is considered. The initial values of the pressures applied are slightly larger than the corresponding static collapse pressures of the shells obtained on the basis of trescas yield criterion. The maximum kinematically admissible deflections for a cantilever shell as well as a shell clamped at both ends are presented for various values of the shell parameter. Author

N66-37261# RAND Corp., Santa Monica, Calif.
DYNAMIC STABILITY OF A THIN CYLINDER UNDER RADIAL PRESSURE
T. C. Fan Jun. 1966 47 p refs
(Contract AF 49(638)-1700; Proj. RAND)
(RM-4583-PR; AD-635644) CFSTI: HC $2.00/MF $0.50

A study is made of how a cylinder behaves when it is subjected to a transient external pressure. In this memorandum, only the instability of the cylinder is examined. This is termed dynamic stability, since the loading is time-dependent. The motions in the three principal directions of a cylinder are purposely considered together to see the influence of their interaction on the mode of failure, compared to earlier work for a single motion. The results show that the mode of failure varies with geometry, numbers of buckle waves for a given loading, and material selected. The influence of the loading rate is also studied. Author (TAB)

N66-37308*# New York Univ., N. Y. Courant Inst. of Mathematical Sciences.
A NON-LINEAR SHELL THEORY COMPARED WITH THE CLASSICAL THREE DIMENSIONAL THEORY OF ELASTICITY
Chester B. Sensenig Aug. 1966 97 p refs
(Grants NsG-412; NSF GP-3465; Contract Nonr-285(46))
(NASA-CR-78246; IMM-349) CFSTI: HC $3.00/MF $0.75 CSCL 20K

A nonlinear theory for the equilibrium deformation of homogeneous isotropic shells is derived and compared with the classical three dimensional nonlinear theory of elasticity. The comparison is made by examining the errors which result when displacements satisfying the equilibrium equations and surface

traction boundary conditions of the shell theory are substituted into those of the classical three dimension theory. It is shown that the parameters E_q (any error resulting from an equilibrium equation) and E_e (a surface boundary condition at the edge) and their derivatives have a stated number of zeros along each line normal to the middle surface. Additionally it is shown that the low degree terms in the displacement polynomials and their derivatives are more significant than the high degree terms at points that are not near the edge. H.S.W.

N66-37318*# Douglas Aircraft Co., Inc., Santa Monica, Calif. Missile and Space Systems Div.
DEVELOPMENT OF VIBRATION DESIGN PROCEDURES FOR REPRESENTATIVE STRUCTURAL TYPES Final Technical Report, Sep. 1965 - Jul. 1966
D. E. Hines and J. H. Gunning Aug. 1966 108 p refs
(Contract NAS8-20549)
(NASA-CR-78200; DAC-59301) CFSTI: HC $4.00/MF $0.75
CSCL 20K

An experimental study was conducted to (1) define the effects of multiple modes on random fatigue, (2) establish the effect of light damping, resulting from damping tape, on random fatigue results obtained with cantilevered beam type fatigue specimens, (3) establish the feasibility of a design factor approach for space vehicle bracketry, and (4) establish the feasibility of design nomograms for space vehicle bracketry. The test specimens consisted of four sets of 12 cantilevered beams and two sets of 6 brackets. The effects of multi-mode response on random fatigue for a specific case has been treated and a procedure for handling multi-modes developed. Methods for other specific multi-mode responses are discussed and procedures hypothesized. For the tests conducted, the effects of light damping on test data were negligible in that no significant reduction in data scatter was noted as compared to non-damped specimens. The design factor approach as applied to bracket structure was a feasible approach and typical design nomographs were developed for specific bracket types. Author

N66-37443# Army Materials Research Agency, Watertown, Mass. Material Engineering Div.
EDGE CRACK IN A SEMI-INFINITE SHEET BY POWER SERIES
Oscar L. Bowie and James J. Mc Laughlin Jun. 1966 11 p refs
(AMRA-TR-66-16; AD-635650) CFSTI: HC $1.00/MF $0.50

A power series procedure developed for solving the plane elastic problem for edge notches in a semi-infinite sheet is considered when cracks occur in the notch boundary. The resulting mathematical singularities are considered for the illustrative problem of an edge crack in a semi-infinite sheet. Numerical agreement with Koiter's solution is found in an effective manner. Author (TAB)

N66-37447# Brown Univ., Providence, R. I. Div. of Engineering.
THE BEHAVIOR OF A RIGID-PLASTIC COLUMN SUBJECTED TO A TRANSVERSE DYNAMIC DISTURBANCE
L. S. S. Lee and J. B. Martin Apr. 1966 34 p refs
(Contracts N189(181)57827A(X); N189(181)59217A(X))
(BU/DTMB/8; AD-635691) CFSTI: HC $2.00/MF $0.50

The deformation of a pinned end axially loaded rigid-plastic beam-column subjected to a particular type of transverse motion is studied. Attention is directed primarily to determining whether or not the transverse displacements are unbounded. Author (TAB)

N66-37451# Polytechnic Inst. of Brooklyn, N. Y. Dept. of Aerospace Engineering and Applied Mechanics.
PROPAGATION OF HARMONIC WAVES IN COMPOSITE CIRCULAR CYLINDRICAL SHELLS. PART I: THEORETICAL INVESTIGATION
Anthony E. Armenakas May 1966 32 p refs
(Contract Nonr-839(40) FBM)
(PIBAL-924; AD-635789) CFSTI: HC $2.00/MF $0.50

In this investigation, the propagation of harmonic waves of an arbitrary number of circumferential nodes travelling in composite, traction-free, circular cylindrical shells, is studied on the basis of the linear, three-dimensional theory of elasticity. The composite shells consist of a circular inner layer composed of one material, bounded by and bonded to a circular outer casing made of another material. Author (TAB)

N66-37458# General American Transportation Corp., Niles, Ill. MRD Div.
STUDIES IN THE PERFORATION OF THIN METALLIC PLATES BY PROJECTILE IMPACT. I: NORMAL IMPACT OF CIRCULAR CYLINDERS
L. E. Fugelso and F. H. Bloedow Natick, Mass., Army Natick Labs., Jun. 1966 134 p refs *Its* Tech. Rept.-66-58-CM
(Contract DA-19-129-AMC-247(N))
(MR-1250; C&OM-9; AD-636224) CFSTI: HC $4.00/MF $1.00

The ballistic parameters were determined analytically and experimentally for the perforation of aluminum alloy and titanium alloy plates by normal impact of steel cylinders. Analytical predictions of the perforation parameters were prepared on the basis of determination of the critical perforation and residual velocities, discriminated among the various models and further experimentation verified the analytical description of the perforation process. One model of perforation was found which adequately describes the ballistic parameters for the normal impact of steel cylinders into aluminum alloy and titanium alloy plates for impact velocities up to 5000ft/sec and plate thicknesses up to 0.25 inches. Author (TAB)

N66-37464# Naval Ordnance Lab., White Oak, Md.
MEANS FOR INCREASING INTERLAMINAR SHEAR RESISTANCE IN FILAMENT WOUND STRUCTURES Interim Report
Carl E. Mueller, S. P. Prosen, and F. Robert Barnet 8 Jun. 1966 49 p refs
(NOLTR-66-85; AD-636146) CFSTI: HC $2.00/MF $0.50

Engineering evidence supports the belief that performance of filament wound glass reinforced plastics structures is limited by interlaminar shear resistance. Different mechanical techniques were devised, which for a given composite system, lead to significant improvements in interlaminar shear strength. This was demonstrated on uniaxially wound NOL Rings: First, when very small fibers and/or whiskers were incorporated into the resin in low percentages and, second, when fiberfoamed glass roving was used as the basic reinforcement. However, it was noted that some loss in compression modulus must be suffered. Author (TAB)

N66-37523*# General Motors Corp., Santa Barbara, Calif.
MEASUREMENTS OF SHOCK WAVE PRESSURES GENERATED BY HYPERVELOCITY IMPACTS IN ALUMINUM
Jacques A. Charest Nov. 1966 26 p refs
(Contract NAS1-1118)
(NASA-CR-78399; TR64-58) CFSTI: HC $2.00/MF $0.50
CSCL 20K

The results of an experimental technique which has been used for determining maximum shock wave pressures generated by hypervelocity impacts of 0.476-cm aluminum spheres into 1100-0 aluminum targets are presented and discussed. The experimental approach consists of measuring free-surface particle velocities upon arrival of shock waves at the rear surface of targets. Shock wave pressures were, therefore, calculated from available shock-wave data for aluminum using the approximation that free-surface particle velocity is twice the particle velocity behind the shock inside the targets. Measurements were made for various thicknesses of targets and

compared with values predicted from hydrodynamic calculations. The experimental results, which were obtained at an impact velocity of 7.32 km/sec, show a very close agreement above 100 kilobars with values calculated at 7.32 and 7.62 km/sec. From the calculated and measured values of peak shock wave amplitude, the pressure is found to decay as the inverse of the 1.6-power dependence of the distance from the impace point. Author

N66-37535# Grumman Aircraft Engineering Corp., Bethpage, N. Y.

A SECOND ORDER SHELL THEORY FOR ORTHOTROPIC CIRCULAR CYLINDRICAL SHELLS

Jacques Crouzet-Pascal and Allan Pifko Jun. 1966 38 p refs Presented at the 5th U.S. Natl. Congr. of Appl. Mech., Minn. Univ., 14–17 Jun. 1966

(Contract Nonr-3465(00) FBM)

(RE-261J; AD-486130)

Equations are developed governing the small deformations of orthotropic, circular cylindrical shells, valid for a range of thicknesses beyond the scope of the classical shell theory. The cylindrical orthotropy of the shells is treated in complete generality. Assumptions which incorporate, in a consistent manner, the effect of transverse shear and normal stress deformations are made on both the stresses and displacements. A consistent set of equilibrium equations, stress-strain relations and boundary conditions is then derived by means of the variational theorem developed by Reissner. Essentially, two sets of results, differing only in their degree of generality, are presented. One, the more general, consists of the set of shell equations in which the coefficients of the load, stress and deformation quantities remain arbitrary, subject to a specific choice of the functions which describe the radial distribution of the stresses. The other consists of the same set of equations, in which, however, the coefficients are evaluated for a specific transverse representation of the stresses. TAB

N66-37536# General Electric Co., Philadelphia, Pa. Missile and Space Div.

EFFECT OF END CONDITIONS OF THE BUCKLING OF CYLINDRICAL SHELLS UNDER AXIAL COMPRESSION IMPACT

A. P. Coppa May 1966 41 p refs Presented at the 69th Ann. Meeting of the ASTM, 26 Jun.–1 Jul. 1966

(Contract AF 33(657)-10220)

(R66SD24; AD-484695)

Experimentally observed effects of edge conditions on the buckling behavior of cylindrical shells under axial compression impact are presented. Three effects are discussed, namely those due to (1) inward radial displacement restraint of the shell wall, (2) asymmetry of the applied loading resulting from obliquity between the impact plate and the end cross section plane of the shell, and (3) impact velocity. It is shown that restraint of an initially free edge against inward radial displacement has two prominent effects: (1) to produce moderate increase in the buckling load, and (2) to force the formation of symmetrical buckling modes local to the restraint even for shells which tend to buckle in the asymmetrical mode. Another result is that although the initial response can be strongly influenced by the edge condition, the subsequent response is virtually independent of it. Author (TAB)

N66-37539*# Southwest Research Inst., San Antonio, Tex. Dept. of Mechanical Sciences.

A COMPARISON OF FLEXIBLE AND RIGID RING BAFFLES FOR SLOSH SUPPRESSION Technical Report No. 1

Luis R. Garza 17 Aug. 1966 46 p refs

(Contract NAS8-20290; SwRI Proj. 02-1848)

(NASA-CR-78355) CFSTI: HC $2.00/MF $0.50 CSCL 20K

A test program to determine the effectiveness of flexible ring baffles as liquid slosh suppressors was conducted. A comparison of flexible and rigid ring baffles is presented in terms of liquid damping, first mode sloshing resonant frequency, and maximum baffle depth for no rotational slosh. Author

N66-37587# Authority Health and Safety Branch, United Kingdom Atomic Energy Authority, London (England). Safeguards Div.

THE SAFETY OF PRESSURE VESSELS AGAINST FAST FRACTURE

W. H. Irvine, E. Bevitt, and A. Quirk 1966 17 p refs

(AHSB(S)-R-107) CFSTI: HC $1.00/MF $0.50

The historical background of the present research programme on cyclic crack growth and fast fracture in pressure vessels is given and the significance and application of the experimental results from this programme in relation to reactor safety are discussed. An outline is given of the direction of future work. Author

N66-37589# France. Office National d'Etudes et de Recherches Aerospatiales, Chatillon-sous-Bagneux.

INTEREST AND REALIZATION OF PURE BENDING TESTS IN THE ELASTO-VISCO-PLASTIC DOMAIN [INTERET ET REALISATION DES ESSAIS DE FLEXION CIRCULAIRE DANS LE DOMAINE ELASTO-VISCO-PLASTIQUE]

Roger Labourdette 1966 47 p refs In FRENCH; ENGLISH summary

(ONERA-TN-99) CFSTI: HC $2.00/MF $0.50

Disadvantages of the simple tensile tests are noted, the possibilities of pure bending tests to determine the mechanical characteristics of materials are examined. A pure–bending testing machine for hardening, creep, and relaxation tests at room and high temperatures is presented; the means of measurement (bending moment, radius of curvature) are such that they can be simultaneously recorded and seen. It is verified that quasi static pure bending tests at room temperature allow the materials behaviour in simple tension and compression to be found. The comparison of the results obtained, with those given by tension and compression tests, in the case of two duraluminiums [tempered and annealed] shows a very good agreement. Author

33 THERMODYNAMICS AND COMBUSTION

Includes ablation, cooling, heating, heat transfer, thermal balance, and other thermal effects; and combustion theory. For related information see also: 12 Fluid Mechanics; and 27 Propellants.

N66-36426*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.

RADIATIVE INTERACTIONS BETWEEN ABSORBING-EMITTING AND GLOWING MEDIA WITH INTERNAL ENERGY GENERATION

John R. Howell Washington, NASA, Sep. 1966 31 p refs

(NASA-TN-D-3614) CFSTI: HC $2.00/MF $0.50 CSCL 20M

An analytical study of the local energy flux and emissive power in two adjacent regions is given. Each region is assigned a radiation absorption coefficient, mass flow rate, heat capacity, and volumetric energy source. The effect of these parameters and of the relative thickness of the regions is examined. The regions are assumed to be infinite, parallel layers of finite thickness in one case, and coaxial cylinders of finite radius in another. The problem of determining the local one-dimensional emissive power and radiant energy flux is solved by using a second-order diffusion

solution with emissive power jump boundary conditions where applicable, and in the parameter ranges where such an approach is invalid a Monte Carlo transport analysis is used. The diffusion solution for the cases examined is accurate for optical thickness greater than about 1. The regions are assumed to be gray and have constant properties. A sample problem which demonstrates the use of the derived equations is presented. Author

N66-36551# General Electric Co., Daytona Beach, Fla. Apollo Support Div.
MISSILE EXPLOSION SIMULATION
Robert O. Harper *In* Canaveral Council of Tech. Soc. 3d Space Congr. 1966 p 540–546 refs (See N66-36506 22-30)

Digital computer simulations of missile explosions were run to provide an estimate of physical parameters which an explosion measurement system must measure. After an explosion the remotely measured data are used to determine inputs to the hydrodynamic computer code. Iterative methods are then used to fit data points currently capable of measurement and to provide values for other quantities not directly measurable. Results include shock wave position as well as static pressure, dynamic pressure, particle velocity, temperature, density, and energy as functions of both elapsed time and distance from the center of the explosion. Author

N66-36636# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
LAMINAR FLAME IN A TURBULENT FLOW
A. M. Klimov *In its* J. of Appl. Mech. and Tech. Phys. 16 Feb. 1966 p 88–104 refs (See N66-36628 22-23) CFSTI: HC $7.00/MF $1.75

The basic properties of a laminar flame in a nonuniform hydrodynamic field are described, and equations derived therefor. The mechanism of turbulent combustion is discussed, and a possible mechanism of flame attenuation is obtained. R.Ll.

N66-36637# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
PROPAGATION OF ZONE OF CHEMICAL REACTION IN PURE ACETYLENE AND MIXTURES WITH OTHER GASES
B. A. Ivanov and S. M. Kogarko *In its* J. of Appl. Mech. and Tech. Phys. 16 Feb. 1966 p 105–119 refs (See N66-36628 22-23) CFSTI: HC $7.00/MF $1.75

The spontaneous propagation of a flame in pure acetylene and in mixtures with other gases is discussed. Results are presented for experimental research on limiting diameters of flame propagation in pure acetylene in the pressure interval between 0.65 and 4.00 absolute atmospheres, at 18°C temperature. Possible causes of discrepancy between the dependency obtained, and the available source data are discussed. Results are listed for analogous experiments in large-volume closed tubes. Also reported is a theoretical calculation of the decomposition flame temperature of acetylene at 1 a.a. pressure which, by taking into account the disassociation of hydrogen and carbon, was found to equal 2980°K ±50°K. R.Ll.

N66-36638# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
EXPERIMENTAL DETERMINATION OF COEFFICIENT OF THERMAL CONDUCTION OF HEAT-INSULATING MATERIALS BY METHOD OF SELF-SIMULATING CONDITIONS
G. I. Vasil'yev Yu. A. Dem'yanov, V. I. Kurnakov, A. V. Malakhov, Kh. A. Rakhmatulin et al *In its* J. of Appl. Mech. and Tech. Phys. 16 Feb. 1966 p 120–126 refs (See N66-36628 22-23) CFSTI: HC $7.00/MF $1.75

Consideration is given to a method for determining the coefficient of thermal conductivity by using an accurate nonlinear heat-conductivity equation. Experimental data are presented on the thermal conductivity of foam grog with an initial specific gravity of $\gamma_0 = 820$ kg/m^3 in the temperature range of 50° to 750°C. The experiments, which were conducted according to the method of self-simulating conditions, show good agreement with the theoretical results. R. Ll.

N66-36641# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
SCALAR EFFECT AND INFLUENCE OF DURABILITY IN A DIRECTED EXPLOSION
V. M. Kuznetsov and Ye. N. Sher *In its* J. of Appl. Mech. and Tech. Phys. 16 Feb. 1966 p 152–165 refs (See N66-36628 22-23) CFSTI: HC $7.00/MF $1.75

Preliminary experimental results on the scalar effect, and the influence of medium durability in a directed explosion in rocky ground are reported. The question of similarity between detonations in soft and rocky ground is most closely associated with the matter of magnitude of tamping. For a general case, it is mentioned that the index of simulation depending upon the degree of tamping may vary from 3.5 to 7. In a directed explosion in rocky ground it is necessary to take into account the durability properties of the medium, the calculation of which introduces essential corrections in the scheme of an ideal incompressible fluid. The direction of ejection depends on sequence of initiating the charges of the BB (explosive substance), and a delayed detonation in a number of cases may result in an essential decrease of consumption of the BB. R.Ll.

N66-36650# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
GENERALIZATION OF CERTAIN EXPERIMENTS ON CRISIS OF BOILING OF LIQUIDS DURING FORCED MOTION ON BASIS OF THERMODYNAMIC SIMILARITY
L. Ye. Mikhaylov *In its* J. of Appl. Mech. and Tech. Phys. 16 Feb. 1966 p 253–264 refs (See N66-36628 22-23) CFSTI: HC $7.00/MF $1.75

Results of experimental data on the crisis of boiling under conditions of forced motion of three alcohols and water by means of an approximate thermodynamic similarity are presented. A calculation formula for empirical functions of the crisis of boiling during a forced motion of liquids is: $q_* = f(p, w, \Delta t)$ where q_* is the critical density of the heat flux, p is the pressure, w is the speed of liquid, $\Delta t = T - T_s$ is the underheating up to the saturation temperature. It is noted that an analysis of this boiling process from thermodynamic assumptions makes it possible to associate peculiarities of process with such characteristics of substances (e.g., critical parameters, and molecular weight), and to exclude from consideration many other physical parameters (viscosity, surface tension). R.Ll.

N66-36651# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
INVESTIGATION OF MECHANISM OF BOILING DURING LARGE HEAT FLOWS BY MEANS OF PHOTOGRAPHY
N. N. Mamontova *In its* J. of Appl. Mech. and Tech. Phys. 16 Feb. 1966 p 265–270 refs (See N66-36628 22-23) CFSTI: HC $7.00/MF $1.75

The photographic investigation of boiling during large heat flows is reviewed. Experimental data show that the motion of the vapor phase during a nucleate boiling of water heated to saturation temperature, with large heat fluxes, differs greatly from that observed during heat fluxes smaller than $\sim 0.1 q_*$; a coalescence and the formation of huge vapor bubbles are observed. During regimes close to critical conditions for boiling of liquids, the complex and unstable hydrodynamics in a two-phase boundary layer is revealed; hydrodynamics in the region of stable film boiling is more regular. With a rise in pressure, the rate in increment of D_{0u} vapor bubbles decreases. It was also found that the frequency of formation and breakaway diameters of vapor bubbles from the surface of a vapor film ($q < q_*$) also depend on the pressure and density of the heat flux. R.Ll.

N66-36652# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.

METHOD OF BOUNDARY CONDITIONS IN PROBLEMS OF STATIONARY THERMAL CONDUCTIVITY

V. I. Van'ko *In its* J. of Appl. Mech. and Tech. Phys. 16 Feb. 1966 p 271–274 ref (See N66-36628 22-23) CFSTI: HC $7.00/MF $1.75

Preliminary work on the stationary temperature field in the rotor of a multistage turbine (a cylindrical drum with a series of blades located on lateral surfaces) is reviewed. A generalization of this concept is presented in which the problem of thermal interaction between rotor and blades is solved by substituting a certain fictitious coefficient of heat exchange from the working gas to the rotor. An experimental result is readily generalized for an arbitrary number of bodies, in which the propagation of heat is described by a one-dimensional equation. Based on previous results obtained, an equation is also derived for the condition of heat exchange at the point of contact. In a similar manner, it is possible to isolate from the entire system a certain k-th body by removing others to the right and to the left. R.Ll.

N66-36654# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.

INVESTIGATION OF CRISIS OF BOILING DURING THE FLOW OF UNDERHEATED METHYL ALCOHOL

P. I. Povarin *In its* J. of Appl. Mech. and Tech. Phys. 16 Feb. 1966 p 283–292 refs (See N66-36628 22-23) CFSTI: HC $7.00/MF $1.75

Experimental apparatus and test results are reported for the boiling mechanism during the forced flow of methyl alcohol in small-diameter pipes at pressures from 5 to 70 atm, speed of liquid up to 45 m/sec, and underheating up to a saturation temperature from 8°C to 200°C. Resultant data show no influence of tube size on the crisis of boiling of a given liquid. Recorded at all pressures are cases of complication of the crisis of boiling by thermal decomposition of alcohol on the surface of heating, where with an increase of pressure the probability of decomposition increases. From experimental data compiled, it is considered possible to propose the critical equation derived for determining q_* (useful for water, methyl alcohol, and other liquids). R.Ll.

N66-36785# Weapons Research Establishment, Salisbury (Australia).

CONVECTIVE HEATING ON A ROCKET EFFLUX DEFLECTOR

G. Jepps and M. L. Robinson Mar. 1966 31 p refs (WRE-TN-HSA-113) CFSTI: HC $2.00/MF $0.50

To provide data for the design of uncooled rocket efflux deflectors, an investigation of the heating rates in the Blue Streak installation at Woomera has been carried our theoretically and experimentally. The heat transfer coefficient and stagnation temperature at the efflux deflecting surface are calculated theoretically with the aid of model test results. Heat transfer coefficients derived from temperature measurements on steel plates embedded in the deflecting surface are compared with the theoretical results. It is concluded that simple aerodynamic heat ransfer theory can provide an effective engineering estimate of the temperature rise of an efflux deflecting surface. Author

N66-36790*# Colorado State Univ., Fort Collins.

HEAT TRANSFER FROM LARGE DIAMETER PIRANI GAUGES OPERATING DOWN TO A MICROTORR

John E. Braly (M.S. Thesis) Mar. 1966 *In its* Transient and Steady Performance of an Ion Rocket Thrust Augmentor Jan. 1966 47 p refs (See N66-36786 22-28) CFSTI: HC $4.00/MF $1.00

Heat transfer from a cylinder in a symmetrical chamber was investigated for dependence on pressure, size and temperature of the cylinder, and molecular weight of the gas. The system resembles the Pirani type of pressure gauge, with the deviation being the use of thin films on large diameter (~2 cm) cylindrical substrates as the heating and sensing element. This large diameter enhanced the molecular conductivity, and therefore, the sensitive pressure range. Although the temperature of the cylinder is almost constant in the 10^{-4} to 10^{-6} torr range, the potential difference and readability is still increasing with decreasing pressure. Thus, the useful range of such a gauge has been extended two orders of magnitude. C.T.C.

N66-36810# Ballistic Research Labs., Aberdeen Proving Ground, Md.

REFLECTED SHOCK INITIATION OF A CHEMICAL REACTION

Ralph E. Shear May 1966 32 p refs (BRL-MR-1743; AD-635933) CFSTI: HC $2.00/MF $0.50

The Lax finite difference method is used to compute the hydrodynamic flow which results from the initiation of a chemical reaction by a reflected shock wave. The chemical reaction is assumed to be irreversible and of first order; initial conditions are chosen such that negligible reaction occurs behind the incident shock front. Author (TAB)

N66-36830# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.

JOURNAL OF ENGINEERING PHYSICS Selected Articles

18 Jan. 1966 40 p refs Transl. into ENGLISH from Inzh.-Fiz. Zh. (USSR), v. 7, no. 4, 1964 p 44–50, 74–80, 114–120 (FTD-MT-65-182; TT-66-61580; AD-634806) CFSTI: HC $2.00/MF $0.50

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N66-36831# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.

THE QUESTION OF THE CALCULATION OF VISCOSITY OF REAL GASES

A. A. Vasserman and V. A. Rabinovich *In its* J. of Eng. Phys. 18 Jan. 1966 p 1–10 refs (See N66-36830 22-33) CFSTI: HC $2.00/MF $0.50

There is shown the expediency of using the equation of state of a real gas, represented by elementary functions for calculation of viscosity by the equation of I. F. Golubev in a wide range of variation of parameters. The equation for the viscosity of air is compiled, and calculations are carried out in the interval of temperatures 0°–1000°C and pressures (1–1000) 10^5 newtons/m^2. Author

N66-36832# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.

DIFFERENTIAL METHODS OF INVESTIGATION OF RADIATION HEAT TRANSFER

V. N. Adrianov and G. L. Polyak *In its* J. of Eng. Phys. 18 Jan. 1966 p 11–23 refs (See N66-36830 22-33) CFSTI: HC $2.00/MF $0.50

In the article are considered differential methods of investigating radiation heat transfer which, thanks to their comparative simplicity, have opened new possibilities. Exposition of the development of the methods is given in historical sequence. Author

N66-36833# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.

GENERAL INJECTION EQUATION FOR MIXERS DURING WORK WITH VARIABLE STREAM PARAMETERS

A. Ye. Yerinov and B. S. Soroka *In its* J. of Eng. Phys. 18 Jan. 1966 p 25–35 refs (See N66-36830 22-33) CFSTI: HC $2.00/MF $0.50

A general equation is derived which describes mixing of gas and air streams during burning of gas in injection burners, working on variable flow parameters. The nonadiabaticity of a gas-air mixture flow during entrance into the tunnel of a burner is considered. Author

N66-36921# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.

FLAME PROPAGATION IN LAMINAR AND TURBULENT FLOWS

A. P. Kovalev, A. S. Ippolitov, Yu. M. Torgonenko, D. Bkhaduri, N. I. Chelnokov, et al *In its* J. of Eng. Phys. 12 Jan. 1966 p 10–20 refs (See N66-36919 22-12) CFSTI: HC $1.00/MF $0.50

A flame propagation theory for turbulent flows is presented, along with a method for calculating the velocity of flame propagation in turbulent flows. The method is based on the use of dependences between time-averaged parameters of turbulent burning and the characteristics of turbulent exchange. The theory of flame propagation rests on the assumption that differential heat-conduction equations are identically applicable both for laminar and turbulent flows if, in the latter, time-averaged quantities are used, and the concept of coefficients of molecular or turbulent heat conduction is applied. Differential equations based on the theory are formulated and solved by analog computer for the combustion of methane–air mixtures. The results of the solution indicated a considerable increase in the velocity of propagation, and the width of the front in the transition from laminar to turbulent flow. Curves are given showing temperatures of flame fronts of laminar and turbulent regimes. E.A.O.

N66-36993# Dartmouth Coll., Hanover, N. H. Thayer School of Engineering.

TWO-PHASE FLOW AND BOILING HEAT TRANSFER Quarterly Progress Report, Apr. – Jun. 1965

G. B. Wallis, J. M. Turner, P. E. Meyer, and D. E. Runge [1965] 13 p refs

(Contract AT(30-1)-3114-1)

(NYO-3114-9; EVRAEC-1451) CFSTI: HC $1.00/MF $0.50

Work on co-current upwards annular flow is continuing. An investigation of upwards annular-mist vertical flow was undertaken. A summary is given of work on the rise velocity of cylindrical bubbles in inclined tubes. Author (NSA)

N66-37027*# Lockheed Missiles and Space Co., Palo Alto, Calif.

CONVECTIVE AND RADIATIVE HEAT TRANSFER DURING SUPERORBITAL ENTRY

H. Hoshizaki and K. H. Wilson Washington, NASA, Sep. 1966 69 p refs

(Contract NAS7-295)

(NASA-CR-584) CFSTI: HC $2.50/MF $0.75 CSCL 20M

The convective and radiative heat transfer to vehicles entering planetary atmospheres at superorbital velocities is investigated. An integral method is employed to determine the radiative and convective heating around a blunt body. The effect of mass injection, radiative emission and absorption, radiation cooling, and coupling between convection and radiation are included in the analysis. The absorption coefficients of the shock-layer gas, as well as the injected ablation products are determined as a function of particle-number density, temperature, and radiation frequency. The results obtained show that self-absorption can reduce the radiative heating by an order of magnitude but has little effect on the convective heating. The nose radius which results in the minimum total heat-transfer rate at the stagnation point is much larger (6 ft to 10 ft diam. at $U_\infty = 50{,}000$ fps) than the values indicated by an optically thin analysis. It is shown that the total stagnation-point heat-transfer rate is a very weak function of the nose radius, contrary to the results obtained from an optically thin analysis. Author

N66-37045*# National Aeronautics and Space Administration, Lewis Research Center, Cleveland, Ohio.

SHADOW SHIELD EXPERIMENTAL STUDIES

R. H. Knoll, E. R. Bartoo, and R. J. Boyle Washington, NASA, 1966 26 p refs Presented at Conf. on Long-Term Cyro-Propellant Storage in Space, Huntsville, Ala., 12–13 Oct. 1966

(NASA-TM-X-52238) CFSTI: HC $2.00/MF $0.50 CSCL 20M

Experiments were performed on multiple flatplate shadow shields to determine the effect of shield spacing, number, emissivity, and lateral conduction on thermal performance. In general, the analytical results closely agreed with experimental data. Analytical results for targeted shields (coated annular rings) demonstrated a method of shield temperature control and were in close agreement with experimental data. Tests on a complete shadow shield system demonstrated the interaction between shields and their supporting structure and how strut heat leaks could be reduced. The use of a ring with a shield material stretched across one or both sides provided a lightweight highly efficient shield. Author

N66-37048*# National Aeronautics and Space Administration, Marshall Space Flight Center, Huntsville, Ala.

THERMOPHYSICS RESEARCH AT MSFC RESEARCH ACHIEVEMENTS REVIEW, SERIES NO. 2

Washington, NASA, 1965 42 p refs

(NASA-TM-X-53490) CFSTI: HC $2.00/MF $0.50 CSCL 20M

The scope and status of thermophysics research at MSFC is given in this report. It includes work in the thermal space environment, the physics of radiation and radiative properties of solids, computer programs for thermal control, thermal similitude of time-dependent problems, effects of space environment on thermal control coatings, infrared physics, and thermal flight experiments. The report covers theoretical research, early experimental studies, and some early results of thermal experiments on Pegasus I. Author

N66-37058# Lexington Labs., Inc., Cambridge, Mass.

THERMAL RADIATION CHARACTERISTICS OF TRANSPARENT, SEMI-TRANSPARENT AND TRANSLUCENT MATERIALS UNDER NON-ISOTHERMAL CONDITIONS Final Report

Henry A. Hobbs and Robert C. Folweiler Wright-Patterson AFB, Ohio, AF Mater. Lab., Mar. 1966 128 p refs

(Contract AF 33(657)-11280)

(ASD-TDR-65-719, Pt. III; AD-635621) CFSTI: HC $4.00/MF $1.00

Over the range of wavelengths from one to six microns where oxide ceramics are partially transparent, radiant energy emission must be treated as a volume rather than a surface phenomena. As a result the absorption coefficient (mainly determined by microstructure) are important variables. In addition, temperature gradients affect radiant energy emission so that the effective 'emissivity' under non-isothermal conditions is neither a material constant nor a sample constant. Analytical relationships were derived for spectral radiant energy emission as a function of absorption coefficient, scattering coefficient, surface temperature and temperature gradient. Experimental measurements of non-isothermal radiant energy emission of Al_2O_3 and $SrTiO_3$ are in agreement with these calculations. Analytical relations and experimental measurements for diffuse and parallel light transmission are reported. Comparison of the hamaker approximation with an exact solution show that the approximation is suitable for these materials and conditions. Author (TAB)

N66-37059 Bureau of Mines, Bartlesville, Okla. Petroleum Research Center.

THERMODYNAMIC PROPERTIES OF ORGANIC DERIVATIVES OF THE LIGHTER ELEMENTS Annual Technical Summary Report, 1 Mar. 1965–1 Mar. 1966

W. D. Good, H. L. Finke, S. S. Todd, and D. R. Douslin Mar. 1966 27 p refs

(AFOSR-66-1389; AD-635296) CFSTI: HC $2.00/MF $0.50

Thermochemical research was carried out on trimethylamineborane, triethylamineborane, aluminum borohydride, lithium alkyls, hexafluorobenzene, and diamines. Results presented for trimethylamineborane and triethylamineborane include: enthalpies of combustion and formation, molal heat capacities of the condensed phases, phase transformation and melting point temperatures, third law entropies, Gibbs energies and equilibrium constants of formation. A scheme was developed for an improved evaluation of the N-F thermochemical bond energy through experimental determinations of the enthalpies of combustion of the related diamines. The status of work on aluminum borohydride and the lithium alkyls was reviewed. Experimental measurements on the enthalpies of vaporization and vapor heat capacity of hexafluorobenzene were completed. Author (TAB)

N66-37100# Army Natick Labs., Mass. Pioneering Research Div.

THERMAL CONDUCTIVITY OF VITREOUS SILICA: SELECTED VALUES

Lois C. K. Carwile and Harold J. Hoge Jul. 1966 41 p refs

(TR-67-7-PR; AD-636276) CFSTI: HC $2.00/MF $0.50

The published literature on the thermal conductivity of vitreous silica has been assembled and the results critically evaluated. Best values of thermal conductivity as a function of temperature have been selected. These are presented in both graphical and tabular form. They cover the range 80° to 660° K and published data extending from 3° to 2100° K are shown in the graphs. An attempt was made to consult all work that could significantly affect the choice of best values. Published papers were located with the aid of Chemical Abstracts, Physics Abstracts, the Thermophysical Properties Retrieval Guide, and some other general sources. In addition, relevant references in the papers themselves were followed up until a substantially 'closed system' had been generated, as shown by the fact that no new references were being turned up. Author (TAB)

N66-37147*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.

EFFECTS OF SUBCOOLING AND GRAVITY LEVEL ON BOILING IN THE DISCRETE BUBBLE REGION

Thomas H. Cochran and John C. Aydelott Washington, NASA, Sep. 1966 41 p refs Film Supplement Number C-246 to this report is available on loan from Lewis Res. Center

(124-09-03-01-22)

(NASA-TN-D-3449) CFSTI: HC $2.00/MF $0.50 CSCL 20M

The effects of changes in subcooling and gravity level are investigated for water boiling at low heat flux from a flat horizontal surface. The zero gravity data were obtained by allowing the experimental package to free fall in a 100-foot drop tower, which permitted the attainment of less than 10^{-5} times earth gravity. An analysis of the dynamics of a generated bubble resulted in a new approach to the formulation of the buoyancy force and the definition of a force associated with the unbalanced pressure across the top surface of the bubble. The force associated with liquid inertia was obtained by the use of Newton's second law of motion. Application of the analysis to experimental data indicated that this newly defined pressure force was of major importance in bringing about bubble separation. Additional investigation showed that nucleate boiling was independent of gravity at high subcooling. Author

N66-37277*# Douglas Aircraft Co., Inc., Santa Monica, Calif. Missile and Space Systems Div.

THERMAL ABSORPTION IN SEEDED GRASS Semiannual Report

Valerie C. Burkig May 1966 30 p refs

(Contract NASw-1310)

(NASA-CR-78152; DAC-59208) CFSTI: HC $2.00/MF $0.50 CSCL 20M

Measurements are reported of maximum temperature rise when dispersions of fine particles of graphite, iron, tungsten, tantalum carbide, and tungsten carbide in helium are exposed to radiation from a xenon flash tube. Some processes are suggested to explain why the measured values fall far short of the calculated temperature rises. Author

N66-37281*# Army Missile Command, Huntsville, Ala. Research Branch.

PREVENTION, DETECTION, AND SUPPRESSION OF HYDROGEN EXPLOSIONS IN AEROSPACE VEHICLES

G. J. Caras 31 Mar. 1966 59 p refs Sponsored in part by NASA

(NASA-CR-78268; RSIC-486) CFSTI: HC $2.50/MF $0.75 CSCL 21B

This report reviews and summarizes the hazards to aerospace vehicles caused by hydrogen. Topics such as flammability limits of hydrogen in hydrogen-oxygen and hydrogen-air mixtures, methods of detecting hazardous conditions, and means of inhibiting fires and explosions are discussed. Although relatively few references were found in the literature concerning hydrogen fire and explosion hazards in aerospace vehicles specifically, it is generally believed that many of the procedures used in the handling, storage, and transportation of liquid hydrogen in more conventional applications also apply to hydrogen used as a fuel in space vehicles. Author

N66-37293*# National Aeronautics and Space Administration. Manned Spacecraft Center, Houston, Tex.

THE EFFECT OF PROTUBERANCES, CAVITIES, AND ANGLE OF ATTACK ON THE WIND-TUNNEL PRESSURE AND HEAT-TRANSFER DISTRIBUTION FOR THE APOLLO COMMAND MODULE

John J. Bertin Washington, NASA, Oct. 1966 58 p refs

(NASA-TM-X-1234) CFSTI: HC $2.50/MF $0.75 CSCL 20M

Heat-transfer-rate and pressure distributions obtained in wind tunnels for the Apollo command module having neither cavities nor protuberances are presented for angles of attack from 0° to 33°. The wind tunnel conditions include free-stream Mach numbers from 6 to 10, with Reynolds numbers from 0.17×10^6 to 1.2×10^6, based on the free-stream fluid properties and the maximum body diameter of the model. The measured heating-rate and pressure distributions are compared with theoretical distributions. In the pitch plane of the spherical heat shield, modified Newtonian pressures approximate the measured values (except near the stagnation point and near the toroidal section), while the experimental heating rates are between the values calculated for two-dimensional flow and axisymmetric flow. Also presented are data illustrating the effect on the heat transfer to the Apollo reentry configuration of cavities and protuberances. The measurements were made at a free-stream Mach number of 10 for Reynolds numbers from 1.37×10^6 to 2.56×10^6. The data indicate significant increases in the heat-transfer rate over large regions of the command module, due to the presence of protuberances and cavities. Author

N66-37302*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.

COMPARISON OF ONE-DIMENSIONAL AND TWO-DIMENSIONAL HEAT-TRANSFER CALCULATIONS IN CENTRAL FIN-TUBE RADIATORS

Norbert O. Stockman, Edward D. Bittner, and Earl L. Sprague Washington, NASA, Sep. 1966 31 p refs
(120-27-04-36-22)
(NASA-TN-D-3645) CFSTI: HC $2.00/MF $0.50 CSCL 20M

An analysis is given of the two-dimensional heat transfer, including gray body radiant interchange, in the cross section of a central fin-tube radiator panel. Results of this analysis are used to evaluate several one-dimensional methods of varying complexity for calculating the heat rejection rate of a central fin-tube radiator panel. Most methods gave good agreement with the two-dimensional results. In view of the excellent agreement of one of the simpler methods which neglects tube wall temperature drop and accounts for radiant interchange between fin and tube simply by using the projected area of the tube, it seems unwarranted to use the more complex methods which gave no better agreement. Details of the numerical method of solution of the two-dimensional equations are given in an appendix. Author

N66-37325*# United Nuclear Corp., White Plains, N. Y. Development Div.
HYDROGEN THERMAL CONDUCTIVITY AT TEMPERATURES FROM 2000 TO 4000°F Final Report
S. L. Israel, T. D. Hawkins, R. T. Salter, and S. C. Hyman 14 Apr. 1964 132 p refs
(Contract NAS3-3205; UNC Proj. 2194)
(NASA-CR-78167; UNC-5082) CFSTI: HC $4.00/MF $1.00 CSCL 20M

The thermal conductivity of hydrogen at 150 psia was determined from the measured effective conductivity of porous tungsten specimens filled with pressurized hydrogen. A truncated-sphere model of the porous structure was used to relate the gas conductivity to the effective conductivity of the gas-filled specimen. Effective conductivities were determined from temperature measurements on the upper circular surface of the right circular cylindrical porous specimen heated by high frequency induction currents. Author

N66-37333# General Electric Co., San Jose, Calif. Atomic Power Equipment Dept.
TWO-PHASE FLOW AND HEAT TRANSFER IN MULTIROD GEOMETRIES Fourth and Fifth Quarterly Progress Reports, 26 Jul. 1965 - 25 Jan. 1966
Feb. 1966 35 p
(Contract AT(04-3)-189)
(GEAP-5056) CFSTI: HC $2.00/MF $0.50

A series of two-phase flow structure tests using vertical upflow of air and water at 85 to 90 psia in a 1-inch i.d. round tube and concentric annulus (1-inch tube with 1/2-inch center rod) was completed. Local void fraction, local quality, local slip ratio, and linear velocity profiles for both phases were determined by the isokinetic sample-probe technique. Film-flow rates were determined by wall suction through porous walls. The time-dependent nature of the flow structure was investigaged with a "continuity probe" and pressure transducers. Typical results are presented. Author (NSA)

N66-37337# California Univ., Livermore. Lawrence Radiation Lab.
CONTACT CONDUCTANCE MEASUREMENTS DURING TRANSIENT HEATING
Dale A. Schauer and Warren H. Giedt (Calif. Univ. Davis) 20 Oct. 1965 10 p refs
(Contract W-7405-ENG-48)
(UCRL-14227, Rev. 1) CFSTI: HC $1.00/MF $0.50

An experimental method is described for determining the interface conductance between two plates during transient heat transfer. The technique is based on heating one plate in about 100 μsec with a capacitor-bank discharge and then recording the contacting-surface temperatures of the two slabs as they come to equilibrium. Results are presented for combinations of: (1) aluminum and stainless steel with contact-surface finishes of 5–5 μin. AA (arithmetic average), 12–30 AA, 15–38 AA, and 50–35 AA; and (2) stainless steel and ceramic with contact-surface surface finishes of 31–38 AA, and 64–38 AA. The pressure was varied from 100 to 2000 psi. For metallic contacts the conductance increased about 200% with time. The reverse behavior occurred with the metal-ceramic contacts. Author (NSA)

N66-37384# Air Force Inst. of Tech., Wright-Patterson AFB, Ohio. School of Engineering.
EFFECT OF VIBRATION ON THE HEAT TRANSFER RATE FROM CYLINDERS IN FREE CONVECTION IN AIR
Leon H. Chaffee (M.S. Thesis) Jun. 1966 85 p refs
(GAM/ME/66B-10; AD-635976) CFSTI: HC $3.00/MF $0.75

The study was a follow-on investigation of the effects of sinusoidal vibration on the heat transfer rate from cylinders in free convection in air. The purpose was to obtain and correlate heat transfer data in the region of the critical Reynolds number, to investigate the effect of the vibration at higher Reynolds numbers through the use of a larger diameter cylinder, and to obtain schlieren photographs of the boundary layer in the vicinity of the critical Reynolds number. Results show that each cylinder displays a similar characteristic pattern progressing from a region in which the heat transfer rate is independent of vibration, through a transition region, to a region where the heat transfer rate generally parallels the recommended forced convection curve of McAdams and is a function only of the vibration intensity. An increased frequency shifts the transition region in the direction of higher vibration intensities. Schlieren photographs show a considerable increase in turbulence in the boundary layer through the transition region. Author (TAB)

N66-37389# Brown Univ., Providence, R. I. Div. of Applied Mathematics.
ON THE THERMODYNAMICS OF ELASTIC MATERIALS
Morton E. Gurtin May 1966 19 p refs
(Contract Nonr-562(40))
(TR-12; AD-635816) CFSTI: HC $1.00/MF $0.50

In a previous paper (Arch. Rational Mech. Anal. v19, p339, 1965) it was shown that in the absence of couple stresses and multipolar effects the Clausius-Duhem inequality requires that every elastic material be simple; i.e. that the stress, energy and entropy depend at most on the deformation gradient and temperature at the same point. It is the purpose of this paper to show that the theorem can be established in a more direct manner provided local behavior is assumed from the outset. Author (TAB)

N66-37518*# Massachusetts Inst. of Tech., Cambridge. Dept. of Mechanical Engineering.
THERMAL CONTACT RESISTANCE
Borivoje Budimira Mikic and Warren Max Rohsenow Sep. 1966 130 p refs *Its* Rept.-4542-41
(Grant NGR-22-009-065)
(NASA-CR-78319) CFSTI: HC $4.00/MF $1.00 CSCL 20M

In theoretical work on predicting thermal contact resistance, emphasis was focused on the characteristics of rough nominally flat metallic surfaces in a vacuum, and fluid environments; smooth wavy surfaces in a vacuum environment; and rough wavy surfaces in a vacuum environment. A thermal analysis was conducted to find analytical solutions for the theraml contact conductance under steady state conditions. The surface analysis, in which the surfaces are treated as random processes with Gaussian distribution of height, relates the interface geometry to the actual contact area. The two-part deformation analysis gives dependence between the load supported by the interface and (1) the actual contact area, and (2) the contact spots distribution for rough spherically wavy surfaces. The result of the first part is based on the plastic deformation of surface asperities. The second part considers, through the

equivalent contour area model, the combined effect of spherical waviness and roughness on the problem of contact spots spreading at the interface. Prediction of thermal contact conductance is compared with experimental data; good agreement was found between the measured and predicted values. M.G.J.

N66-37526*# General Electric Co., Philadelphia, Pa. Missile and Space Div.

FREE MOLECULE HEAT TRANSFER IN THE IONOSPHERE

Leon M. Gilbert and Sinclaire M. Scala Jan. 1965 34 p refs (Contract NASr-32)

(NASA-CR-78377; R65SD41) CFSTI: HC $2.00/MF $0.50 CSCL20M

The usual free molecular heat transfer and mass flux expressions are modified in this study to allow for a multi-component chemically reacting mixture of gases. These expressions include the effects which result from the recombination interactions at the solid-gas interface caused by the transport of atomic and ionized particles to the vehicle. Results of the numerical solutions are presented graphically as functions of the altitude and flight velocity. The magnitudes of the various modes of energy transferred to the vehicle are compared. In particular, it is shown that for many free molecular situations of interest (i.e., flight speeds which are equal or greater in magnitude than escape velocities), the kinetic terms in the transfer equations are the dominant ones. However, for certain attainable combinations of altitude and flight speed and when all radiative heating is neglected, the total energy transfer can exceed the available kinetic energy by a factor as large as four. Author

N66-37586# United Kingdom Atomic Energy Authority, Risley (England). The Reactor Group.

SOME MEASUREMENTS OF THE ACOUSTIC SPECTRUM PRODUCED BY SUB-COOLED NUCLEATE BOILING

I. D. Macleod 1966 22 p refs

(TRG-1205(R)) CFSTI: HC $1.00/MF $0.50

The sound spectra produced by boiling in highly sub-cooled water in several sizes of containing vessel have analysed. There is no single frequency common to all environments which could be used to detect boiling, and the spectrum produced depends critically on the vessel dimensions and to a lesser extent on the presence of gas bubbles. Further, sound spectra similar to boiling sound spectra can be produced by replacing the heater by a white noise source. Author

34 GENERAL

Includes reports of a broad nature related to industrial applications and technology, and to basic research; defense aspects; law and related legal matters; and legislative hearings and documents.

N66-36497*# National Academy of Sciences–National Research Council, Washington, D. C. Space Science Board.

POTENTIAL APPLICATION OF ELECTRON-OPTICAL METHODS TO STORAGE OF INFORMATION FOR DIRECT RETRIEVAL

Humberto Fernández-Morán (Chicago Univ.) *In its* Biol. and the Exploration of Mars 1966 p503–506 refs (See N66-36466 22-04)CFSTI 22-04) CFSTI: HC $8.27/MF $2.75

Proposed is the development of a miniature microscope for the condensation and retrieval of information from Mars and other planetary missions. Results of an experiment using a commercial electron microscope which demonstrated the applicability of this approach to the problem of information collection, storage, and retrieval; are analyzed. It is proposed that all of the information obtained from the Mars missions and other extraterrestrial missions be condensed by electron optical demagnification (ratio of demagnification 1:1,000 to 1:50,000 or more). Possible approaches to the problem of demagnification of the image, and inherent problems associated with retrieval, are also discussed. S.C.W.

N66-36538# Radiation, Inc., Melbourne, Fla.

COMBINING R AND D AND FOLLOW-ON PRODUCTION IN A SINGLE CONTRACT

John W. Simmons *In* Canaveral Council of Tech. Soc. 3d Space Congr. 1966 p 420–426 (See N66-36506 22-30)

The combined contract, designed to reduce or eliminate problems which have caused concern to the government and still not go to the extreme and require the contractor excessive risk, is discussed. It is pointed out that considerations should be given to the specific type of procurement. The cost plus fixed fee, cost plus incentive fee, fixed price incentive, and fixed price contracts are compared. Examples are included, and additional conditions are mentioned. N.E.N.

N66-36539# International Business Machines Corp., Bethesda, Md. Federal Systems Div.

CAPABILITY MANAGEMENT: AN APPROACH TO SELLING RESEARCH AND DEVELOPMENT

Salvatore F. Divita *In* Canaveral Council of Tech. Soc. 3d Space Congr. 1966 p 427–432 (See N66-36506 22-30)

This paper contains a new concept in the approach to marketing R&D capabilities to the defense/space market. The concept is based primarily on establishing capability managers as the focal point of the marketing function. It suggests that this is only one of the several new concepts that are needed to meet the challenges of this unique marketplace. The paper reviews the current approach to selling R&D and tries to relate it to the workings of the marketplace. It points out some of the fundamental shortcomings of the current practice and, in building upon this examination, it goes on to suggest a new approach to the problem. Author

N66-36540# Martin Co., Denver, Colo.

MARTIN'S TITAN III INCENTIVES Progress Report, Jan. 1963–Mar. 1966

Robert W. Chapman *In* Canaveral Council of Tech. Soc. 3d Space Congr. 1966 p 433–436 refs (See N66-36506 22-30)

The incentive contract, and resulting schedule performance, flight performance, and cost performance are described. The event and milestone scoring are mentioned. It was concluded that the successful experiences on the Titan III program prove that incentives do work towards motivating superior performance. It was further shown that success is contingent upon an excellent degree of program definition, and on the ability of management to bring all personnel in as participants. N.E.N.

N66-36541# Brown Engineering Co., Inc., Huntsville, Ala.

THE COMPATIBILITY OF VALUE ENGINEERING AND CONFIGURATION MANAGEMENT

Marvin Wasserman *In* Canaveral Council of Tech. Soc. 3d Space Congr. 1966 p 437–451 refs (See N66-36506 22-30)

This report is aimed at management levels responsible for ensuring system compatibility and mission success. The report provides a familiarization with the philosophies of system management and the interrelationships of program management, system engineering, and management tools. Value engineering and configuration management are discussed as the catalysts to be integrated into the management network, thus assuring system compatibility and mission success at the lowest overall cost. Author

N66-36542# Radiation, Inc., Melbourne, Fla.
POTENTIAL AND HAZARDS OF THE OCEANOGRAPHIC MARKET FOR THE AEROSPACE INDUSTRY
Meryl C. Burns *In* Canaveral Council of Tech. Soc. 3d Space Congr. 1966 p 452–465 (See N66-36506 22-30)

The oceanography market will provide a potential for diversification by the aerospace industry. An analysis of this market and the correlation between oceanographic requirements and aerospace resources establishes the relative potentials and hazards for selected market sectors. A minimum risk entry into the potentially profitable and diverse oceanography market is proposed. Author

N66-36722# Joint Publications Research Service, Washington, D. C.
SOVIET DEVELOPMENTS IN AUTOMATED PRODUCTION CONTROL SYSTEMS
14 Sep. 1966 18 p Transl. into ENGLISH from Radyans'ka Ukrayina (Kiev), 9 Jun. 1966 p 3
(JPRS-37593; TT-66-34021) CFSTI: $1.00

The problem of introducing automated production control systems into industrial enterprise is presented in brief summaries of conference speeches. Methods used by plants and institutes to incororate electronic computers for production control are reported. Application of these control systems in enterprises occupied with the small-series production of a large number of articles is stressed. S.P.

N66-37028*# Michigan Univ., Ann Arbor.
PEACEFUL USES OF EARTH-OBSERVATION SPACECRAFT. VOLUME I: INTRODUCTION AND SUMMARY
Washington, NASA, Sep. 1966 71 p refs
(Contract NASw-1084)
(NASA-CR-586) CFSTI: HC $2.50/MF $0.75 CSCL 22B

A program is discussed to obtain substantial scientific and economic information from sensors aboard earth orbiting spacecraft for earth mapping, collection of agricultural census data, forest inventory, wildlife habitat assessment, detection of sea ice, measurement of sea surface temperatures, and investigations concerning air pollution and archaeology. Major emphasis was placed on spacecraft uses in the survey and management of important natural resources. The applications and benefits, and the sensor requirements and experiments are summarized. It was concluded that potentially valuable applications exist for operational spacecraft, and anticipated results range from purely scientific significance to political, social, and economic benefits. N.E.N.

N66-37029*# Michigan Univ., Ann Arbor.
PEACEFUL USES OF EARTH-OBSERVATION SPACECRAFT. VOLUME II: SURVEY OF APPLICATIONS AND BENEFITS
Washington, NASA, Sep. 1966 177 p refs
(Contract NASw-1084)
(NASA-CR-587) CFSTI: HC $3.25/MF $1.25 CSCL 22B

A detailed discussion of possible applications for observation spacecraft in technical and scientific fields is presented. For each field, the current state of development is described and the major existing problems are reviewed with particular attention to those problems in which the need for improved data collection is evident. Applications of orbital sensing techniques to the acquisition of needed data are discussed, with estimates of resolution, repetition frequency, and other performance requirements placed on sensing devices. The geographic studies provide a broad overview of the other areas, which include agriculture, forest and water resources, wildlife and fisheries, oceanography, geology, archaeology and air pollution. N.E.N.

N66-37030*# Michigan Univ., Ann Arbor.
PEACEFUL USES OF EARTH-OBSERVATION SPACECRAFT. VOLUME III: SENSOR REQUIREMENTS AND EXPERIMENTS
Washington, NASA, Sep. 1966 249 p refs
(Contract NASw-1084)
(NASA-CR-588) CFSTI: HC $3.75/MF $1.50 CSCL 22B

The preorbital program is described briefly, and the uses of satellite reconnaissance systems and the orbital phase of the experimental program are discussed in detail. The types of sensors considered include photographic cameras, infrared scanners, multispectral sensing systems, noncoherent and synthetic aperture radar, microwave radiometers, and laser altimeters. The objectives of the manned earth orbiting experiments are to ascertain the optimum conditions for sensor operation and to demonstrate the feasibility of future operational systems. Engineering and scientific advances needed are delineated, and limitations in space reconnaissance due to atmospheric conditions are identified. N.E.N.

N66-37061 Arizona State Univ., Tempe.
AN INVESTIGATION OF THIXOTROPY IN HIGHLY PLASTIC CLAYS
Morris Dee Swensen (M.S. Thesis) May 1966 94 p refs
(AD-635233) CFSTI: HC $3.00/MF $0.75

This study was made to establish the effect of thixotropy on a specified clay and to determine if a means could be established where thixotropy can be predicted and then used in design. A review was made of the theories of thixotropy and how the strength increase takes place. Investigations performed by other authors were reviewed and their conclusions on the feasibility of using thixotropic strength increase in design was discussed. Two clays were used in the study. Each was prepared at three different water contents near the liquid limit. The samples were placed in two types of containers and stored under water. Shear strength is affected by changes in water content: therefore a secondary study was to determine the effectiveness of the methods used to control the water content of the stored samples. Samples were stored a maximum of 150 days. Tests were made at specified times during this period to determine the strength increase that developed with time. It was found that the strength increase of the clays tested could be defined by an equation. The accuracy of the equation was not determined for all water contents but only those used in the study. Author (TAB)

N66-37101# Army Research Office, Durham, N. C.
RESEARCH IN PROGRESS DURING CALENDAR YEAR 1965
[1965] 372 p refs
(AD-636091) CFSTI: HC $7.00/MF $1.75

Research progress is presented in the following fields: physics, chemistry, mathematics, engineering, metallurgy and ceramics. TAB

N66-37369*# Geological Survey, Flagstaff, Ariz.
***IN SITU* DRILLING PROGRAM**
Robert A. Elmer and Lawrence A. Walters *In its* Invest. of *In Situ* Phys. Properties of Surface and Subsurface Site Mater. by Eng. Geophys. Tech. Jul. 1966 p 37–40 (See N66-37366 22-13) CFSTI: HC $4.25/MF $2.00

A summary is presented of operating costs and work accomplishments in the NASA failing project in situ drilling program. The drill rig is mounted on a truck with a gross carrying capacity of 15,000 pounds. It is equipped with a 31.5 foot hydraulically raised and lowered mast that can handle 20 foot lengths of drill rod. The rig has been used to drill 9,400 feet of shot holes and 2,100 feet of diamond core holes. This operation was achieved at a total operating cost of $51,740. It is estimated that this amount of work done on a contract basis would have cost $66,000 without yielding many of the intangible benefits derived from the project owned rig. C.T.C.

N66-37431# System Development Corp., Santa Monica, Calif.
INFORMATION SCIENCE AND TECHNOLOGY FOR 1966, PART I Bibliography

Frances I. Neeland 1 Jul. 1966 54 p refs
(TM-3008/001/00; AD-635200) CFSTI: HC $3.00/MF $0.50

The continuing bibliography is intended primarily for the use of the authors of chapters in 'Annual Review of Information Science and Technology.' The style of entries has been modified to suit the author's requirements. In order to reduce the gaps left in the 1965 issues, this part of the bibliography incorporates additional 1965 references cited by the authors of the first volume of the 'Review.' Author (TAB)

N66-37459# RAND Corp., Santa Monica, Calif.
THE STATUS OF AND DEVELOPMENT PROSPECTS FOR SCIENTIFIC RESEARCH IN CYBERNETICS AT THE ACADEMY OF SCIENCES OF THE UKRAINIAN SSR
12 Jul. 1966 11 p Transl. into ENGLISH from Dopovidi Akad. Nauk Ukr. RSR (Kiev), no. 1, 1966 p 129–132
(LT-66-30; TT-66-61779; AD-635576) CFSTI: HC $1.00/MF $0.50

Translation of Russian research: the status of and development prospects for scientific research in cybernetics at the Academy of Sciences of the Ukrainian SSR. TAB

N66-37472# European Space Research Organization, Paris (France). Dept. of Technical Programmes.
COST EVALUATION OF AN EIGHT-YEAR SOUNDING ROCKET PROGRAMME
G. Dondi and J. W. Tripp Jul. 1966 60 p
(ESRO-TN-12) CFSTI: HC $3.00/MF $0.75

A basic cost formula for the financial evaluation of a long-term sounding rocket launching program is developed. The main expenditures are grouped in rocket and payload expenditure, range expenditure, and general expenditure (development and personnel training costs). A set of formulas giving unit costs are then derived at different levels of breakdown. In order to apply the study to the actual operational program financial data were assembled. A summary of these data is presented, together with an estimation of the reliability of the different classes of information. Computer programs, developed for quick analysis and evaluation of different launching programs, are described, and examples of the computer printout are given. Finally some proposals for improvements on the computer programs and for the extension of the study are put forward. Author (ESRO)

N66-37486# Aktiebolaget Atomenergi, Stockholm (Sweden).
RECIPIENT CAPACITY OF TVAEREN, A BALTIC BAY
P-O. Agnedal and S. O. W. Bergstroem Jul. 1966 23 p refs Presented at the IAEA Symp. on the Disposal of Radioactive Wastes into Seas, Oceans and Surface Waters, Vienna, May 16–20, 1960
(AE-234) CFSTI: HC $1.00/MF $0.50

The research station at Studsvik is described. Situated on the Baltic coast, it includes several reactors and laboratories, a waste disposal plant serving both the station and waste producers outside Studsvik. A storage plant for irradiated fuel from power reactors has been build. A short description is given of the fauna and flora and important foodwebs are discussed. Accumulation factors from water to fish are given for iron, cobalt and zinc. Permissible releases have been calculated using relevant accumulation factors. Author (ESRO)

N66-37488# Technische Univ., Berlin (West Germany). Institut fuer Raumfahrttechnik.
SOCIO-ECONOMIC MODEL OF THE PLANET EARTH ("SEMPE"). REPORT NO. 1: COMPREHENSIVE PROJECT DESCRIPTION [SOZIO-OEKONOMISCHES MODELL DES PLANETEN ERDE. BERICHT NO. 1: ZUSAMMENFASSENDE PROJEKTBESCHREIBUNG]
H. H. Koelle 30 Sep. 1965 28 p refs In GERMAN
(TUB-IR-1965/3) CFSTI: HC $2.00/MF $0.50

Discusses a mathematical model which tries to describe and extrapolate per unit time the economic and social situation of the planet earth. For this purpose the planet was divided into 15 geographical units. Parameters are defined for the measurement of the performance of this socio-economic system. The model consists of a world trade sector and an economic value sector. The purpose of this model is to simulate the socio-economic efficacy of our planet and to illustrate their effects in order to make possible a better insight into the growth functions of our civilization. The model could be used to help answer questions like: To what extent would aeronautics research and development seem to be economically desirable for the future. Author (ESRO)

N66-37489# Teschnische Univ., Berlin (West Germany). Institut fuer Raumfahrttechnik.
SOCIO-ECONOMIC MODEL OF THE PLANET EARTH ("SEMPE") First Interim Report [SOZIO-OEKONOMISCHES MODELL DES PLANETEN ERDE ("SEMPE") I. Zwischenbericht]
H. H. Koelle 1 Jun. 1966 39 p refs In GERMAN
(TUB-IR-2/1966) CFSTI: HC $2.00/MF $0.50

For an actual trial quantitative measurement of the state of civilization, an appropriate concept for a mathematical model has to be developed to create a frame within which the temporal development of the human society and its surroundings can be quantitatively measured. 81 values were chosen for 8 partial domains of the civilization which by means of weighted value functions deliver a quantitative picture of the state of present and past. The results of an example quantitative measurement of the U.S. and Germany within the period of 1950 and 1970 are given. Further improvement and development possibilities of this model are discussed, the purpose of which is to gain a better insight into the socio-economic situation on our planet and to serve possibly as a tool to estimate as a first approximation the relative value of different alternatives in the political-economic field. Author (ESRO)

N66-37501# Technische Univ., Berlin (West Germany). Institut fuer Raumfahrttechnik.
A PROCEDURE TO MEASURE THE WORTH OF SPACE PROGRAMS
H. H. Koelle 15 Jul. 1965 37 p
(TUB-IR-1965-2) CFSTI: HC $2.00/MF $0.50

A Worth Analysis Model (WAM) is presented as a part of a broad Program Analysis and Evaluation Model (PAEM) designed to evaluate the relative worth of alternative space program plans. It is analogous to the force structure evaluation procedures used by the Department of Defense. Worth Estimating Relationships (WER) are derived which correlate the program yield (transportation volume, cost effectiveness of transportation, and time when milestones are achieved) with the specified program objectives. Worth is defined as the degree, in percent, to which the specified program objectives are achieved. A weighted list of program objectives and a list of representative measurements of program yields are proposed for initial testing of the WAM. Author (ESRO)

N66-37516*# Midwest Research Inst., Kansas City, Mo.
AN ANALYSIS OF THE IMPACT OF FEDERAL EXPENDITURES ON SELECTED SUB-STATE REGIONS Final Report, 1 Jan. 1962–31 Jul. 1966
Darwin W. Daicoff et al [1966] 47 p refs
(Contract NASr-63(04); MRI Proj. 2571-M)
(NASA-CR-78395) CFSTI: HC $2.00/MF $0.50 CSCL 05C

Procedures for determining the impact of the aerospace program on the economy of substate regions were investigated. The annual estimates of county income for a six-state midwestern region from 1950 to 1962 provided the basis for the regional

impact analysis. It was found that it was possible to formulate a model, resting upon the ability to differentiate between exogenous and endogenous income, which could be tested using available data. Statistical methods were applied, and it was determined that rather consistent estimates of the impact of changes in the level of exogenous income on the level of total income could be derived for 9 of the 11 selected areas. Data were developed which measure defense procurement, military wages and salaries, and civilian wages and salaries. An analysis of the impact of changes in the level of defense spending in each metropolitan area showed that the relative contribution of defense spending to income growth varied widely. It was felt that the most important conclusion is that a local impact model can be developed. N.E.N.

N66-37529# California Univ., Los Angeles. Div. of Research.
AN EVALUATION OF BARRIERS TO THE DELEGATION OF AUTHORITY IN FORMAL ORGANIZATIONS
Patrick Meacham Williams (San Jose State Coll.) Jul. 1966 20 p refs
(NASA-RP-13)

A number of "barriers" to effective authority delegation were grouped into categories associated with the manager, his subordinates, and his organization. Sixty-five managers were then asked to evaluate the importance of each of these obstacles by means of numerical ratings, open-end written responses, and individual interviews. The major results of this survey established the following reasons for the inability to delegate decision making: (1) The manager viewed his subordinate as the principle barrier to delegation; (2) the manager remained basically confident in himself as a decision maker and rated his own ability higher than any other barrier to delegation; (3) the manager's impatience to develop the decision making ability in others. G.G.

N66-37540*# California Univ., Berkeley. Space Sciences Lab.
THE DICHOTOMIES OF ENGINEERING DESIGN
Ian I. Mitroff Aug. 1966 23 p refs *Its* Internal Working Paper No. 51
(Grant NsG-243-62)
(NASA-CR-78381) CFSTI: HC $1.00/MF $0.50 CSCL 05E

The decision rules which an engineer uses in design have been computerized in an effort to analyze the engineering design process. It was found that several traditional distinctions must be reexamined, since they can be shown to break down; this applies especially to design optimizations that strictly separate between the abstract and the concrete aspects and thus prevent an attempt to describe engineering as a social process. It was found quite impossible to program the job of a single engineer without in turn programming the co-producer's and the user's of the design. G.G.

N66-37542*# Massachusetts Inst. of Tech., Cambridge. Center for Space Research.
THE R & D FACTOR IN INTERNATIONAL TRADE AND INTERNATIONAL INVESTMENT OF UNITED STATES INDUSTRIES
William Gruber, Dileep Mehta, and Raymond Vernon Jun. 1966 46 p refs
(Grant NsG-496)
(NASA-CR-78382; CSR-TR-66-8) CSFTI: HC $2.00/MF $0.50 CSCL 05C

The functioning of research and development in the creation of new products, new processes, and new systems that lead to industrial concentrations and large scale operations of United States industries in the framework of international trade are studied. International economic investments constitute a certain hold on export positions through their subsidiarized sales force; but neither exports nor overseas investment have much prominence when normalized by the level of activities of the same industries in the United States. G.G.

N66-37543*# Washington Univ., St. Louis, Mo. Dept. of Economics.
PROGRAM BUDGETING AND THE SPACE PROGRAM
Murray L. Weidenbaum Sep. 1966 21 p refs *Its* Paper 6607
(Grant NsG-342)
(NASA-CR-78386) CFSTI: HC $1.00/MF $0.50 CSCL 05A

The implementation of the Planning-Programming-Budgeting System (PPBS) by all major Federal Government agencies presents both important opportunities and major problems to the Nation's space program. The first part of this paper describes the main features of the PPBS effort. The second part analyzes possible applications to and impacts on space activities. Author

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